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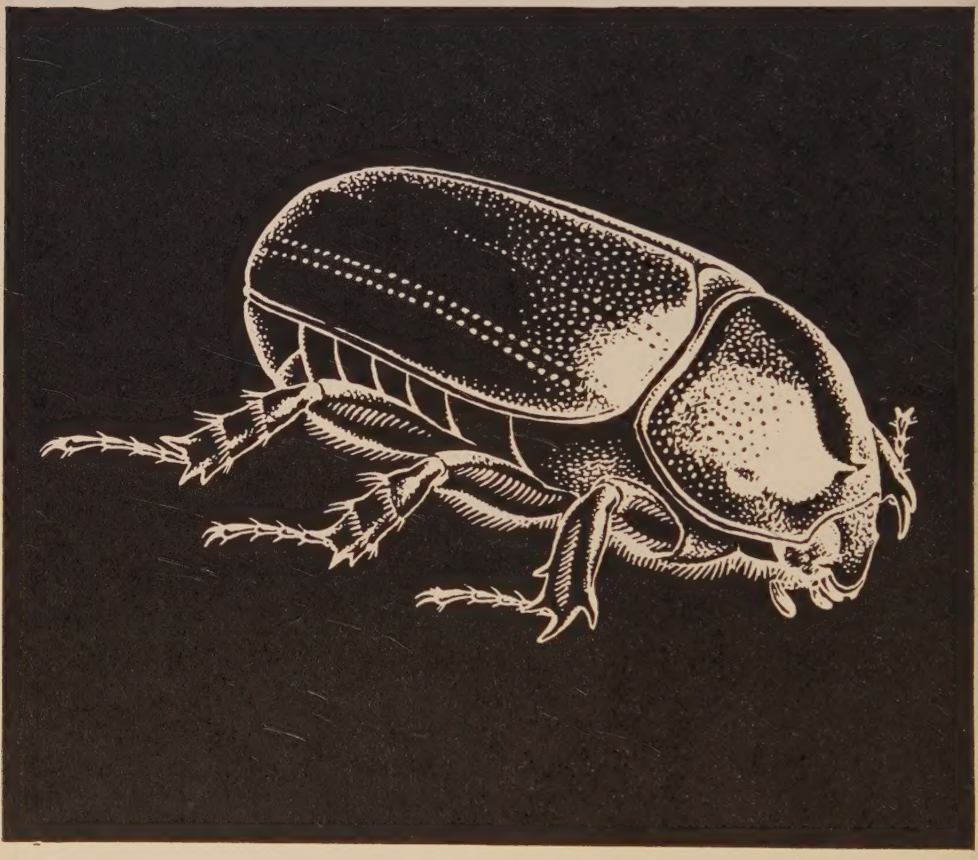

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Distribution maps of pests.—Series A (Agricultural), nos. 109–114. London, Commonw. Inst. Ent., 1960.

These maps are nos. 109–114 of a series already noticed [*R.A.E.*, A **40** 203; **48** 39] and deal, respectively, with *Dacus dorsalis* Hend., *D. tryoni* (Frogg.), *Dialeurodes citri* (Ashm.), *Aleurocanthus spiniferus* Quaint., *Myzus ascalonicus* Doncaster and *Elasmopalpus lignosellus* (Zell.).

Ruinard (J.). **Onderzoekingen omtrent levenswijze, economische betekenis en bestrijdingsmogelijkheden der stengelboorders van het suikerriet op Java.** (Investigations into bionomics, economical importance and possibilities of control of the sugarcane stalkborers in Java.)—*Proefschr. Landbouwhogesch. Wageningen*, 222 pp., 11 figs., 12½ pp. refs. Hilversum, Ahrend-Globe, 1958. (With a summary in English.)

The stalk borers that infest sugar-cane in Java are *Sesamia inferens* (Wlk.), *Chilotraea auricilia* (Dudgn.), *Argyroploce schistaceana* (Sn.) and *Proceras sacchariphagus* Bojer. They were of only occasional occurrence before 1942, but became much more important after 1945. *A. schistaceana* attacks mainly young canes, causing dead hearts, *P. sacchariphagus* and *C. auricilia* are more harmful, attacking older canes during the formation of the internodes, and *S. inferens* is of little significance. Field and laboratory investigations on *C. auricilia* showed that the egg, larval and pupal stages lasted about 5, 20–46 and 7 days, respectively; males and females occurred in equal numbers, the larval stage lasted about four days longer for females than for males, and the adult females laid 73–412 eggs each. The newly hatched larvae of this species and of *P. sacchariphagus* generally penetrated the young leaf sheaths and then bored into the tender internodes that were surrounded by them.

Investigations on methods of determining the extent of the infestation showed that the percentage of infested stems is not a reliable criterion. The percentage of internally infested internodes is the best measure, but can seldom be determined, and the percentage of internodes showing borer holes, which gives adequate results, is that selected for use. Dead hearts are usually few, but many stems may be killed during the ripening period. Different varieties of cane growing in the same field showed different percentages of infestation. For a given variety, the infestation increased with the thickness of the stem, the heaviness of the cane, the amount of nitrogenous fertiliser supplied, the warmth and dryness of the rainy season and nearness to the coast. Young canes are invaded from full-grown cane, planting material, trash left in the field after harvest and alternative food-plants. Young shoots killed by borers are probably replaced by new ones, but full-grown shoots killed while maturing cannot be replaced. Injury due to borers reduced the specific gravity of the stem and the percentage of sucrose in the juice, and it is estimated that infestation of 1 per cent. of the internodes reduces the yield of sugar by at least 90 lb. per acre. Borer injury tends to be followed by fungus infection and increases the rate of ripening, and hence the risk of harvesting the crop when it is over-ripe; infestation in the upper parts of the stem reduces the yield of planting material.

The eggs, larvae and pupae of the borers are attacked by various insect parasites, notes on which are given, but the possibility of biological control has not been studied. Control by cultural measures appears to be of little value, but soaking the cuttings for an hour in an emulsion containing 0·2 per cent. diazinon appeared to eliminate borers from planting material.

Spraying the plants 25 times at weekly intervals with about 0·7 lb. rotenone per acre or ten times at ten-day intervals with 9 lb. 40 per cent. ryania or 6·75 lb. cryolite per acre reduced the percentage of infested internodes by about half, the best results being obtained when the sprays were aimed at the young leaves. Dusting with the insecticides was unsatisfactory. Of other materials tested, DDT caused increases in populations of *Oligonychus* (*Tetranychus*) *exsiccator* (Zhnt.) and toxaphene, BHC, dieldrin and endrin sometimes resulted in increased borer populations, probably by killing natural enemies. Sprays of 0·45–0·675 lb. rotenone (in derris powder), 4·5–9 lb. cryolite or 6·75–11·25 lb. 40 per cent. ryania per acre, applied at intervals of 7–14 days, are considered the most effective treatments, and as ground machines are not suitable for treatment of large areas, the sprays should be applied from aircraft.

Banerjee (S. N.). **On the incidence of paddy pests in West Bengal.**—*Proc. zool. Soc. Calcutta* **9** (1956) no. 2 pp. 65–83, 3 pls., 1 fig., 14 refs. Calcutta, 1957.

This summary of information on the insects that attack growing rice in West Bengal contains, for each insect, notes on its local name, the injurious stage, the nature of the damage caused, the life-history of the species, the period of incidence, the peak period of infestation, distribution in West Bengal and in the whole of India, a list of notable outbreaks in West Bengal, the extent of the damage, and control measures, together with figures illustrating the various pests.

Marco (R. I.). **Notes on the biological control of pests of agriculture in Chile.**—*FAO Plant Prot. Bull.* **8** no. 3 pp. 25–30, 11 refs. Rome, 1959.

This is a review of work on biological control carried out in Chile since the beginning of the century. Most of it concerns the introduction of insects or other parasites or predators of insect pests of plants, but control of weeds by introduced insects [*cf. R.A.E.*, A **48** 145] is included.

Outbreaks and new records.—*FAO Plant Prot. Bull.* **8** no. 4 pp. 46–47, 4 refs.; no. 5 pp. 57–59, 3 refs. Rome, 1960.

It is reported (p. 47) from the U.S. Department of Agriculture that the pumpkin caterpillar, *Margaronia* (*Diaphania*) *indica* (Saund.), was found in the United States for the first time in November 1959, when it was collected in light-traps at three places in Florida. It feeds mainly on cultivated cucurbits, but no unusual damage attributable to it was observed.

It is reported (p. 58) from India by V. P. Rao that *Eriosoma lanigerum* (Hsm.) was found severely infesting apple at an altitude of about 9,000 ft. at Lachung, Sikkim, and that it was attacked by *Exochomus uropygialis* Muls., which was susceptible to insecticides applied against the aphid, and (pp. 58–59) from Nicaragua by G. H. Berg that *Ceratitis capitata* (Wied.), which had been intercepted in 1959 along the frontier with Costa Rica [*R.A.E.*, A **47** 347], was recently found in the interior of Nicaragua, a trap survey in early 1960 showing numerous examples in the area round Diriamba, an important coffee- and *Citrus*-growing district.

Nour (M. A.). **On "leaf curl" of cotton in the Philippines.**—*FAO Plant Prot. Bull.* **8** no. 5 pp. 55–56, 2 figs., 6 refs. Rome, 1960.

Symptoms attributed to leaf-curl transmitted by *Bemisia tabaci* (Gennadius) were recently recorded on cotton in the Philippines [*R.A.E.*, A **48** 144]. Since symptoms such as those described are readily produced by contamination with derivatives of the weed-killer, 2,4-D [2,4-dichlorophenoxyacetic acid], it is considered unlikely that a virus was involved and even more unlikely that it was that of leaf-curl, which occurs in Africa and causes totally different symptoms from those noted in the Philippines.

Salavin (R. J.). **Notas biológicas sobre la mosca** *Servaisia* (*Protodexia*) *arteagai* **(Blanch.) Rob. (Diptera Sarcophagidae) parásito de la tucura.** [Biological notes on the fly, *Protodexia arteagai*, a locust parasite.]—*Rev. Invest. agríc.* **12** no. 3 pp. 299–310, 3 pls., 12 refs. Buenos Aires, 1958. (With a summary in French.)

Protodexia (*Servaisia*) *arteagai* (Blanch.) [*cf. R.A.E.*, A **27** 214] is a parasite of *Schistocerca cancellata* (Serv.) and *Dichroplus maculipennis* (Blanch.), of which *Trigonophymus arrogans* (Stål) is a synonym, in Argentina. The female of this Sarcophagid inserts its ovipositor between the mandibles of *Dichroplus* and deposits a living larva, but places the larva externally on an individual of *Schistocerca*, into which the larva enters through the cervical membrane. The larvae develop internally, doing so in five days at 30°C. [86°F.] and 70 per cent. relative humidity, but leave their dead hosts for pupation; the prepupal and pupal stages last 3 and 7 days, respectively. The first- and second-instar larvae are described in detail. Parasitism of *Schistocerca*, to which the species seems ill-adapted, is rare.

Blanchard (E. E.). *Contarinia palposa* **sp. nov., parásita del sorgo granífero.** [*C. palposa*, sp.n., a pest of grain sorghum.]—*Rev. Invest. agríc.* **12** no. 4 pp. 423–425, 1 fig. Buenos Aires, 1958.

A species of *Contarinia* found in April 1958 infesting the developing seeds in heads of sorghum in experimental plantings in Argentina is described from the adult male as *C. palposa*, sp.n.; various characters of the male and the terminal antennal segments of the female are figured. The species is distinct from *C. sorghicola* (Coq.), which infests sorghum in other countries, but develops in a similar manner; characters differentiating the two are noted.

López Cristóbal (U.). *Calepitrimerus vitis* **Can. Eriophyidae-Phyllocoptinae, Acarina-Trombidiformes. Parásito específico de la vid nuevo para la fauna argentina.** [*C. vitis*, a specific pest of vines new to the Argentine fauna.]—*Rev. Fac. Agron. La Plata* **34** pt. 1 pp. 91–94, 2 figs., 4 refs. La Plata, 1958.

Damage to vines observed in the region of the Río de la Plata in recent years was found to be due to *Calepitrimerus vitis* (Nal.), an Eriophyid that had not previously been recorded in Argentina. Infestation of the leaf buds in spring caused deformation of the leaves, and attack on the flower buds prevented fruit production. A generation was completed in 30–40 days, according to temperature and relative humidity, and there were up to five a year in dry conditions. Winter was passed beneath the bud scales. Lime-sulphur sprays gave good control in winter and spring, and sprays of wettable sulphur in summer.

Mariconi (F. A. M.). **A "cochonilha vírgula", coccídeo mais prejudicial à laranjeira.** [*Lepidosaphes beckii*, the Coccid most injurious to orange.]—*Biológico* **24** no. 6 pp. 95–103, 2 figs., 10 refs. São Paulo, 1958. (With a summary in English.) **Errata**—*T.c.* no. 11 pp. 245–246.

Lepidosaphes (*Mytilococcus*) *beckii* (Newm.), of which the world distribution is noted and all stages and the life-history briefly described, is the most injurious Coccid on orange in parts of the State of São Paulo, Brazil. Sprays of oil emulsion are usually employed for its control, but, though effective against the nymphs, they give poor results against the adult females at concentrations tolerated by the tree. Experiments with sprays of other materials were carried out in 1956–57. Two preliminary applications of bordeaux mixture, the first alone and the second with DDT, were made in August–September to increase infestation by the Coccid, and insecticidal sprays of 1 per cent. oil emulsion, 0·15 per cent. malathion or methyl-demeton (Metasystox), and 1 per cent. oil emulsion with 0·15 per cent. malathion or methyl-demeton were applied on 5th March, when adult females were numerous, and again on 25th April. Leaves were collected before treatment and 14 days after each application, and the mortality of the adult females determined. Only the spray of oil and malathion gave effective control (over 80 per cent. as calculated by Abbott's formula [*R.A.E.*, A **13** 331]), and a Coccinellid predator, *Pentilia egena* Muls., that was common on the trees was almost eliminated by the first application of the sprays.

Leiderman (L.) & Calcagnolo (G.). **O combate ao "bicho-mineiro" do cafeeiro por meio de polvilhamentos com inseticidas orgânicos.** [Control of the coffee leaf-miner by means of dusts or organic insecticides.]—*Biológico* **24** no. 7 pp. 115–129, 14 refs. São Paulo, 1958.

Tests of the value of organic insecticides in dusts for the control of *Leucoptera* (*Perileucoptera*) *coffeella* (Guér.) on coffee in São Paulo were carried out in 1955, as a supplement to those on sprays [*R.A.E.*, A **47** 138]. The dusts contained 1 per cent. BHC, 1·5 per cent. dieldrin, 10 per cent. toxaphene, 0·5 per cent. parathion or both the last two, and nine applications were made at intervals of three weeks or five at intervals of five weeks, beginning in mid-May. Counts of mined leaves were made 24 hours after each application, but special attention was paid to those made in August, when infestation was at its peak. These showed that all the insecticides except dieldrin at intervals of three weeks and dieldrin and BHC at intervals of five gave significant reductions in percentages of leaves mined; the mixture of parathion and toxaphene was the best, giving 72 and 58·3 per cent. reduction at the two intervals, respectively, and also the greatest reductions in the numbers of mines per plot. A further count, involving greater numbers of leaves, confirmed these results.

Matarrita Acuña (A.) & De Leon Rojas (A.). **Eficiência de diversos inseticidas orgânicos fosforados para o contrôle do tripes da cebola.** [Effectiveness of various organic phosphorus insecticides for the control of thrips on onion.]—*Biológico* **24** no. 7 pp. 134–136, 2 figs., 1 ref. São Paulo, 1958.

In a test in São Paulo in 1957, emulsion sprays containing 0·07 per cent. Chlorthion or malathion or 0·1 per cent. diazinon, applied twice at an interval

of nine days, gave good control of thrips, probably *Thrips tabaci* Lind., on onion and resulted in increased yields. Reinfestation began after five days, and was most rapid for malathion.

Abrahão (J.) & Mamprim (O.). **Cochonilha da raiz do cafeeiro.** [A Coccid on the roots of coffee.]—*Biológico* **24** no. 12 pp. 268–271, 1 fig. São Paulo, 1958.

The roots of coffee in São Paulo are occasionally infested by a mealybug thought to be *Pseudococcus comstocki* (Kuw.), which causes yellowing and falling of the leaves. To test a systemic insecticide for its control, a powder containing 50 per cent. phorate (Thimet) was applied in a shallow trench round each infested plant on 26th March 1958 at 20 g. per 4-year-old plant, the trenches were then refilled, and half of them were watered on the next day, though rain subsequently equalised the treatments. Examination after two months showed that control was good and the condition of the plants much improved.

Carrillo S. (J. L.). **Biología de** *Macrodactylus mexicanus* **Burm.** [Bionomics of *M. mexicanus*.]—*Agric. tec. Méx.* no. 9 pp. 4–5, 3 figs. México, D.F., 1960.

Adults of *Macrodactylus mexicanus* Burm. cause sporadic damage to the foliage of wild and cultivated plants, shrubs and trees in Mexico; the larvae develop on plant roots. A study of the life-cycle of this Melolonthid [*cf. R.A.E.*, A **42** 270] was made in the laboratory in 1957–58, at minimum, maximum and average temperatures of 5, 24 and 20·4°C. [41, 75·2 and 68·72°F.], and it was found that the egg stage, the three larval instars and the pupal stage required 3–4, 4–8, 6–10, 21–26 and 3–4 weeks, respectively. The eggs were laid in groups of 5–30 at depths of 6–12 in. in the soil, and their development and that of the later stages is described.

Candia Z. (D.) & Barnes (D.). **Infestación del maiz en el campo por** *Sitophilus oryzae* **(L.).** [Field infestation of maize by *S. oryzae*.]—*Agric. tec. Méx.* no. 9 pp. 9–10, 2 figs., 5 refs. México, D.F., 1960.

An account is given of experiments in Mexico showing that the amount of damage by *Sitophilus oryzae* (L.) to the ears of maize growing in the field varies with the structure of the husks, long close-fitting husks permitting less infestation.

Sifuentes (J. A.) & Young (W. R.). **El pulgón manchado de la alfalfa y su combate en el Valle del Yaqui.** [The spotted alfalfa aphid and its control in the Yaqui Valley.]—*Agric. tec. Méx.* no. 9 pp. 18–22, 1 fig., 1 graph, 2 refs. México, D.F., 1960.

Therioaphis maculata (Buckt.) causes severe injury to lucerne in the Yaqui Valley of Mexico, where it is thought to have been present since about 1954 [*cf. R.A.E.*, A **45** 11]. Populations are highest in January–July, and losses of forage range up to 50 per cent., with a reduction in quality of the remainder. Tests of insecticides against the aphid were carried out in 1959. In the first, sprays were applied twice, 20 days after one cutting and 15 days before the next, by which time insecticide residues had

disappeared, and aphid counts were made before treatment and after each application. All materials reduced the aphid population, some of them doing so very considerably, and increased the yield; the greatest yield increases (about 100 per cent.) were given by methyl-parathion and methyl-demeton (Metasystox) at total rates of 0·54 and 0·27 lb. per acre for the two applications. A second test gave inconclusive results as to yield increase because of low infestation; parathion, methyl-parathion and methyl-demeton gave good reductions in aphid numbers, but tended to reduce the numbers of *Hippodamia convergens* (Guér.), which is the most important of the insect predators attacking the aphid.

Padilla A. (R.) & Young (W. R.). **Insecticidas selectivos para el combate del pulgón manchado de la alfalfa.** [Selective insecticides for the control of the spotted alfalfa aphid.]—*Agric. tec. Méx.* no. 9 pp. 36–39, 5 figs., 6 refs. México, D.F., 1960.

Experience in Mexico has shown that, in the absence of insecticides, *Hippodamia convergens* (Guér.) and other predators reduce the infestation of lucerne by *Therioaphis maculata* (Buckt.) to within economic limits in 4–6 weeks, but as this implies considerable damage by the aphid to one or two cuttings, the use of insecticides is desirable. Most of these kill the predators and so lead to increased infestation, and tests were therefore carried out in the laboratory in 1959 to find materials toxic to the aphid but not to its natural enemies. The results indicated that BHC was very highly selective in its action, being over 80 times as toxic to the aphid as to Coccinellids, chiefly *H. convergens*, and that Thiodan and methyl-demeton (Metasystox) were 14·6 and 11·3 times as toxic, whereas there was much less difference for malathion, parathion and methyl-parathion, the last of these three being more toxic to the Coccinellids than to the aphid. In a field test in which nine insecticides, including the above, were applied as sprays, all gave highly significant control of the aphid after 24 hours, and all but trichlorphon (Dipterex) also did so after eight days, 0·9 lb. wettable BHC or Thiodan per acre giving complete control.

Gudiño M. (R.) & Guevara C. (J.). **Combate de los barrenadores del camote en el trópico.** [Control of sweet-potato borers in the tropics.] —*Agric. tec. Méx.* no. 9 pp. 49–50, 1 fig. México, D.F., 1960.

Sweet potatoes are widely grown on the gulf coast of Mexico. The tubers are attacked by various insects, including the larvae of *Sylepta elevata* (F.), which has not previously been recorded from Mexico, *Lachnosterna* (*Phyllophaga*) spp., *Diabrotica* spp., Elaterids and *Stenygra histrio* Serv., but the damage is not excessive. The value of soil insecticides against *S. histrio* was tested in 1957–58, diluted dusts being applied to the soil and worked in before planting. Infestation was fairly heavy in 1957, but less so in 1958, and the best results, as measured by yields, were given by heptachlor at 1·8–3·6 lb. per acre; the highest rate, which resulted in the greatest reduction in the percentage of infested plants, is recommended.

Kerr (S. H.) & Brogdon (J. E.). **A new pest of magnolias.**—*Florida Ent.* **41** no. 4 p. 195, 1 ref. Gainesville, Fla., 1958.

Euzophera ostricolorella Hulst was recently recorded as injurious to yellow-poplar trees [*Liriodendron tulipifera*] in Kentucky and Tennessee

[*R.A.E.*, A **47** 259], and a species tentatively identified as it was found damaging magnolias in nurseries near Macclenny, Florida, in the winter of 1956–57. Attack was confined to the lower few inches of the trunk and the large roots entering the crown, and was mostly superficial, the larval burrows rarely disappearing below the surface. Girdled trees were killed, and less severe injury resulted in yellowing and dropping of the leaves. Only large larvae and pupae were present on 1st February, but many adults had emerged by late March.

English (L. L.). **Illinois trees and shrubs: their insect enemies.**—*Circ. Ill. nat. Hist. Surv.* no. 47, [4+] 92 pp., 60 figs. Urbana, Ill., 1958.

Notes are given on the appearance, bionomics and control of numerous insects that damage ornamental trees and shrubs in Illinois, with general information on the various types of insect feeding, insecticides, and their application in sprays.

Holling (C. S.). **Sensory stimuli involved in the location and selection of sawfly cocoons by small mammals.**—*Canad. J. Zool.* **36** no. 5 pp. 633–653, 4 figs., 15 refs. Ottawa, 1958.

The following is based on the author's summary. The stimuli enabling *Peromyscus maniculatus bairdi*, *Sorex cinereus cinereus* and *Blarina brevicauda talpoides* to find and distinguish between cocoons that contain healthy prepupae of *Neodiprion sertifer* (Geoffr.) and those that contain parasitised or diseased ones were determined in all phases of the search for buried food in field and laboratory investigations in Ontario [*cf. R.A.E.*, A **45** 321; **48** 191]. Only olfactory stimuli were involved in the digging, removing and opening phases, while gustatory stimuli played a part in selection in the eating phase. There were innate preferences and aversions to the gustatory stimuli, but not to the olfactory stimuli. It was only with experience that the animals were able to associate odours from cocoons with the taste of the cocoon contents. Selection of cocoons containing healthy male or female prepupae was also studied. In the digging phase, all species dug more holes over the larger, female cocoons than over the smaller, male cocoons. This selection was not affected by experience and was caused by differences in intensity and not in kind of odour. In the removing and opening phases, *S. c. cinereus* and *P. m. bairdi* removed and opened more male than female cocoons, while *B. b. talpoides* removed and opened more female cocoons. This selection was affected by experience and probably resulted from differences in visual or tactile stimuli. The larger the mammal, the more frequent was the selection of female cocoons.

Holling (C. S.). **Some characteristics of simple types of predation and parasitism.**—*Canad. Ent.* **91** no. 7 pp. 385–398, 7 graphs, 12 refs. Ottawa, 1959.

Previous work indicated that one of the basic components of predation, comprising a response of the consumption of prey by individual predators to changes in prey density and termed the functional response [*R.A.E.*, A **48** 191], may be of importance in population regulation, and it was therefore further examined in an attempt to explain its characteristics. This was done by means of artificial predator-prey situations, in which, over a given

period, a blindfold operator located small sand-paper disks tacked to a table, by touch or, in a more complicated model, by the sound made when they were tapped with a pencil, and removed each one as found. The relation established from the results obtained in the first of these situations, in which the only time-consuming operations were searching and handling the ' prey ' and in which the number of disks picked up increased at a progressively decreasing rate as their density increased, was expressed by the equation $y = \frac{T_t ax}{1 + abx}$, where y is the number of disks removed, x the density of the disks, and T_t the period for which searching is continued, and a and b are constants equal to the rate of searching multiplied by the probability of finding a given disk (the instantaneous rate of discovery) and to the time required to pick up a disk, respectively. In the second situation, the introduction of a third time-consuming factor, identification time, reduced the time available for searching by a fixed amount (c) for each disk removed. Since this is not related to a, the expression $1 + abx$ becomes $1 + (b + c)x$. Other factors that may affect the functional response are satiation in the case of predators and the reduction in the number of available eggs as oviposition nears completion if the concept is applied to parasites. Both can be expressed as time occupied in resting (d), which, if directly proportional to the number of prey or hosts attacked, can be substituted for c.

The validity of the basic functional-response equation when applied to natural situations is demonstrated by its application to published data for fixed numbers of the parasite, *Dahlbominus fuliginosus* (Nees) (*fuscipennis* (Zett.)), searching for cocoons of *Neodiprion sertifer* (Geoffr.) at fixed densities in the laboratory [**42** 245], on a lawn [**44** 402] and in a plantation [**47** 447], for *Chelonus texanus* Cress. searching for eggs of *Anagasta kühniella* (Zell.) [**38** 160], *Cryptus inornatus* Pratt searching for cocoons of *Loxostege sticticalis* (L.) [**38** 397] and *Mormoniella* (*Nasonia*) *vitripennis* (Wlk.) searching for puparia of *Musca domestica* L. [**30** 428]. The equation, which predicts a continually decreasing rate of consumption, is not applicable to the data obtained for small mammals preying on sawfly cocoons [**48** 191], since they indicated an S-shaped rise to maximum consumption; an additional component, which is being investigated, evidently caused the searching rate to be stimulated by each prey found. Equations describing the effects of prey density on the number of prey attacked, proposed by other investigators [*cf.* **24** 6; **42** 245], are discussed.

Bucher (G. E.). **Disease of the larvae of tent caterpillars caused by a sporeforming bacterium.**—*Canad. J. Microbiol.* **3** pp. 695–709, 3 pls., 5 refs. Ottawa, 1957. **Winter rearing of tent caterpillars, *Malacosoma* spp. (Lepidoptera: Lasiocampidae).**—*Canad. Ent.* **91** no. 7 pp. 411–416, 6 refs. Ottawa, 1959.

It is stated in the first of these papers that attempts in 1954 to rear larvae of *Malacosoma pluviale* (Dyar) collected near Vancouver, in British Columbia, were hindered by a disease of which preliminary examination of dead and moribund larvae showed the causal organism to be a bacterium. The following is almost entirely the author's summary of this account of further investigations in 1955. The disease was caused by infection of the gut with a large, motile, spore-forming bacterium, *Bacillus* sp., that increases in size before sporulation and bears the spore without bulging. Attempts to culture it were unsuccessful. The bacterium invades the host with the food and multiplies in the midgut and foregut, producing changes

in the pH and causing dysentery in the host. Sporulation occurs in the gut, and both rods and spores are passed in the excreta and spread the disease. The infected larva loses its appetite, regurgitates excessively, produces wet excreta, decreases markedly in length, and dies in a characteristic short, dry, mummified condition after about a week. Small ingested doses of spores initiate infection in laboratory populations of *M. pluviale* in all instars. *M. americanum* (F.) was also susceptible to the disease, but *M. disstria* Hb. was resistant, only a few individuals dying from it.

In the second paper, the technique adopted for rearing larvae of *M. pluviale* and *M. americanum* during the winter of 1957–58 for use in tests with the bacterium is described, and the following is based almost entirely on the author's summary. The winter diapause of the eggs of both species was terminated by exposing them to a temperature of about 25°F. for 12 weeks at a relative humidity of 80 per cent. Optimum hatch (90–98 per cent.) occurred by mid-December, 23 weeks after oviposition, the interval consisting of six weeks of incubation at 75°F. to permit full development of the embryos, four weeks of conditioning at progressively lower temperatures, 12 weeks of storage at about 25°F. and one week of incubation at 75°F. Food was obtained by forcing leaf buds on apple cuttings of which the dormancy had been broken by exposure for 10–12 weeks to temperatures below freezing-point in cold storage or in the field. Maximum leaf development occurred on stored cuttings by mid-February, 14 weeks after leaf drop in the area of Belleville, Ontario, but smaller quantities of leaves were produced a month earlier by reducing the storage time. Cuttings taken after natural exposure to cold on trees at Belleville produced numerous leaves by the end of February. Treatment of cuttings of *Pyrus* (*Malus*) *baccata* from a place in Alberta, where leaf drop was earlier, provided food by mid-December, at a time when larvae were hatching in numbers. The disease did not develop in the progeny of healthy females reared in the laboratory, but larvae from some egg-masses of *M. pluviale* collected in the field in British Columbia became spontaneously infected with a polyhedral virus and with the bacterial disease. Larvae from healthy colonies had a high survival rate when reared by the methods described.

McMullen (L. H.) & Atkins (M. D.). **Life-history and habits of *Scolytus tsugae* (Swaine) (Coleoptera: Scolytidae) in the interior of British Columbia.**—*Canad. Ent.* **91** no. 7 pp. 416–426, 6 figs., 9 refs. Ottawa, 1959.

Scolytus tsugae (Swaine) occurs throughout the Pacific Coast and Rocky Mountain region of Canada and is common in the interior of British Columbia, where it usually attacks the tops, limbs and logging slash of Douglas fir (*Pseudotsuga menziesii*) and is seldom of economic importance. It is often associated with *Dendroctonus pseudotsugae* Hopk., and its bionomics were accordingly investigated in British Columbia in 1956–58 to provide information for a study of the effects of interspecific competition. *S. tsugae* is closely related to *S. monticolae* (Swaine), which G. R. Hopping considers not to be specifically distinct from it. A comparison of the measurements of 86 females and 24 males from British Columbia with those given by Swaine [*R.A.E.*, A **5** 399] and by M. W. Blackman in his revision of the genus [**23** 343] indicated that the Scolytids dealt with in the present investigation represented the group originally described as two species.

In 1956, the earliest attack at an altitude of 1,400 ft. occurred on 10th July, but in 1957 and 1958, at 2,800 ft., attack was first observed on 28th

June and 29th May, respectively. At 2,100 ft. in 1956, it was first noted on 14th July on a tree felled on 29th June; on three trees felled on 14th July, the initiation of galleries was first observed on 16th July, reached a peak on 19th July and continued until 29th August. Trees felled on 20th April and at fortnightly intervals between 15th May and 15th June were not attacked, but at 2,800 ft. in 1957 poles felled on 6th and 18th May and trees girdled to the heartwood on 17th May all became infested. Furthermore, catches at window flight-traps [**45** 7] in a forested area at the same altitude in 1958 indicated that flight began on 22nd May and continued until 30th July with a peak on 17th June. Attacks mostly occur in trunks 2·5–7 in. in diameter with bark 0·1–0·4 in. thick, in which densities of 20 per sq. ft. were common, but they were also recorded in trunks with diameters of 13 in. and bark 0·7 in. thick at densities of 2·5 per sq. ft. The galleries, which are constructed by the females, run obliquely through the bark to the cambium, where a small chamber is formed, from which they are continued upwards and downwards between the wood and the bark; their average and maximum lengths were 2·01 and 3·6 in., respectively. The eggs are laid singly in niches on both sides of the gallery, and the average and maximum numbers per gallery were 36·7 and 76. The larvae hatched in 9–12 days; in 1956, they were first observed on 27th July, but were not common until 1st August. Their galleries, the average and maximum lengths of which were 1·95 and 3·1 in., at first run at right angles to the egg gallery and then diverge towards one or other of its two ends. Extensive measurements of head capsules indicated that there are four larval instars, and the mean durations of the first three were estimated to be 8·1, 5·6 and 9·3 days, respectively. Most of the larvae in the fourth instar and a few of those in the second and third overwinter. Pupation takes place at the junction of the cambium and wood or in the bark, often immediately below the scales of the outer bark. None of the galleries contained more than one living adult, usually the female, 16–20 days after their construction. The number of dead adults present did not make up the deficiency, and the beetles appear not to migrate, since infested wood placed in cages with freshly cut pieces of *P. menziesii*, *Pinus monticola* and other conifers were not attacked. The male remains near the entrance to the gallery, and may be vulnerable to predators; mutilated adults were often found there. It is also possible that each male may mate with several females in different galleries, since males known to have been associated with gallery construction were seen moving over the bark; furthermore, the ratio of females to males was 4 : 3.

In addition to *Pseudotsuga menziesii*, *S. tsugae* has been reported from several other conifers. In an experiment in which infested sections of *P. menziesii* were placed in cages with freshly cut wood of nine species, including *P. menziesii* in two of the four cages, the preferred timbers, with (in brackets) the number of attacks per sq. ft., were *Pinus monticola* (11·02), *Tsuga heterophylla* (7·29), *Abies lasiocarpa* and *Larix occidentalis* (each with 2·35), and *Pseudotsuga menziesii* (1·86). There were fewer than 0·2 attacks per sq. ft. in *Picea engelmanni*, *Pinus contorta* and *P. ponderosa*, and *Thuja plicata* and *Juniperus scopulorum* were not attacked.

Guppy (J. C.). **Four Hymenoptera newly recorded as parasites of the armyworm,** *Pseudaletia unipuncta* **(Haw.) (Lepidoptera: Noctuidae).**— *Canad. Ent.* **91** no. 7 pp. 426–427, 5 refs. Ottawa, 1959.

Of 20 species of parasitic Hymenoptera reared from larvae and pupae of *Pseudaletia unipuncta* (Haw.) collected near Ottawa in July–August in

1955, 1957 and 1958, four, a Eulophid, *Euplectrus mellipes* Prov., a Braconid, *Microgaster auripes* Prov., and two Ichneumonids, *Hyposoter annulipes* (Cress.) and *Therion sassacus* Vier., had not previously been recorded attacking this Noctuid. Their previously known hosts and distributions are noted. Eggs of *E. mellipes* were laid in a mass on the dorsal thoracic region of the host, and the larvae, of which 5–21 occurred per host, fed gregariously. When fully grown, they dispersed over the body of the host, which died at about this time, and pupated in loose cocoons. The other three are solitary endoparasites. *E. mellipes*, *H. annulipes* and *M. auripes* all destroy the host larvae in the early instars, and the percentage parasitised by them was 6 in 1957 and 8 in 1958. Since the observations were made when about 50 per cent. of the host larvae had reached the fifth or sixth instar, initial parasitism may have been higher.

LeRoux (E. J.) & Reimer (C.). **Variation between samples of immature stages, and of mortalities from some factors, of the eye-spotted bud moth,** *Spilonota ocellana* **(D. & S.) (Lepidoptera: Olethreutidae), and the pistol casebearer,** *Coleophora serratella* **(L.) (Lepidoptera: Coleophoridae), on apple in Quebec.**—*Canad. Ent.* **91** no. 7 pp. 428–449, 1 fig., 40 refs. Ottawa, 1959.

The application in June 1956 of a DDT spray against larvae of *Archips argyrospilus* (Wlk.) in an apple orchard in south-western Quebec that had a rich ground-cover and had received only insecticides known to be harmless to the natural enemies of apple pests over the previous five years was followed in July by an outbreak of *Spilonota ocellana* (Schiff.) and *Coleophora serratella* (L.), of which the latter is normally only a minor pest. Studies were begun in that month to determine the mortality factors affecting the immature stages in order that life tables for successive generations [*R.A.E.*, A **44** 159] could be prepared during the outbreak, and a report on the variation in samples and in some mortality factors noted during the period to 1959 is here given, together with sampling recommendations.

The two species develop simultaneously, and the leaf cluster is the most suitable sample unit for all the immature stages except the overwintering larvae, for which the cluster buds are satisfactory. The mean numbers of clusters per tree and of leaves per cluster remained fairly constant throughout the growing season and from year to year, and the mean number of leaf clusters per tree did not differ significantly from the mean number of cluster buds. The studies were made in a permanent experimental plot 12·7 acres in area and containing 585 trees of one variety; this was divided into four equal blocks, and five trees selected at random were sampled in each. The samples, each of 25 leaf clusters, were taken from each of four equal quadrants (north, south, east and west) in the lower and a similar number in the upper half of the crown. Eggs were sampled in mid-July, larvae of the first four instars from early August to mid-September, overwintering larvae in October and April, overwintered larvae on the foliage from early May to early June, and pupae in mid-June. From statistical analysis of the data obtained, it was found that, for the preparation of life tables, samples should be taken throughout the crown for all stages except, possibly, the pupae, and that the number of clusters from each level should be roughly proportional to the amount of foliage present; samples from one level would probably be adequate for the detection of gross annual fluctuations in numbers, provided that the same

level is sampled each year. There were no appreciable differences between quadrants, except in a few samplings, but, for life-table studies, the sampling of all quadrants is recommended, the number of samples from each being proportional to the amount of foliage. Both sides of the leaves must be examined for eggs. The numbers of clusters per tree recommended for sampling the eggs, summer larvae, overwintering larvae, spring larvae and pupae were 50, 50, 75, 150 and 75, respectively, and the number of trees from which samples should be taken for these stages of *S. ocellana* and (in brackets) *C. serratella* were 25 (10), 40 (15), 25 (15), 50 (15) and 40 (25); tree numbers may need to be increased for very low infestations and might be decreased for high ones.

Eggs were attacked by parasites and predators. There was little mortality among larvae in the first four instars, except in 1958 among newly hatched individuals, which were attacked by predators. Some overwintering larvae of *S. ocellana* were killed by frost or disease, and birds destroyed considerable numbers of overwintering larvae of *C. serratella* in the winter of 1957–58 and preyed on the spring larvae and pupae of *S. ocellana* in the spring of 1958. There was no evidence of attack by arthropod parasites or predators on the spring larvae or pupae of either species.

Kriegler (P. J.) & Myburgh (A. C.). **New spray programme makes pear bud mite a problem once more.**—*Fmg in S. Afr.* **34** no. 7 pp. 20–22, 4 figs. Pretoria, 1958.

Eriophyes pyri (Pgst.) was formerly controlled on pear in South Africa by sulphur sprays applied against fungi and by summer-oil emulsions and nicotine sprays applied against the codling moth [*Cydia pomonella* (L.)] [*cf. R.A.E.*, A **39** 145], but since organic fungicides have been used instead of sulphur against the fungi, increased populations of the mite have caused considerable losses of fruit buds [*cf.* **39** 144]. The life-cycle and control of the mite are briefly discussed. Experiments are in progress, but the control measure at present recommended is the addition of 30 per cent. wettable sulphur at 4 lb. per 100 gal. to the first two or three DDT sprays applied against *C. pomonella*. Pear varieties differ considerably in resistance to the mite, and two of 11 listed are almost completely resistant.

Buyckx (E. J.) & Damoiseau (R.). **Essais de lutte chimique contre *Phytolyma lata*, psyllide gallicole de *Chlorophora excelsa*.**—*Bull. INEAC* **7** no. 6 pp. 375–384, 3 figs. (1 col.), 1 graph, 9 refs. Brussels, 1958.

Although attempts have been made to establish plantations of *Chlorophora excelsa* in the Belgian Congo and other tropical regions of Africa, few trees have been able to persist for more than ten years, mainly because of the terminal damage and subsequent stunting brought about by the massed galls of *Phytolyma lata* (Wlk.) [*cf. R.A.E.*, A **33** 329, etc.]. Control of the Psyllid by opening the galls each week causes a copious sap-flow, which in itself is injurious to the tree, but experience in the Congo in recent years has shown the potential value of systemic and other insecticides, even though sprays have had to be applied every 3–4 weeks to maintain control.

In March 1956, a test was conducted at Yangambi on young plants in baskets, placed in almost full sunlight in a cleared area and cut back to a height of 30 in. three weeks earlier. Parathion, endrin, malathion and

demeton were applied as emulsion sprays at concentrations of 0·025, 0·05, 0·1 and 0·025 per cent., respectively, and after five weekly applications no galls with living occupants were found on plants treated with parathion, endrin or demeton, whereas 38 and 100 per cent. of the malathion-treated and untreated plants bore occupied galls. Endrin was found, in a second series of tests, to be effective for at least four weeks. Young nymphs within the galls were more susceptible to endrin than older ones, but all were killed within five days of application. Adults in the galls were killed less rapidly, and endrin had scarcely any effect on adults outside the galls. The eggs hatch in nine days, and the newly hatched nymphs are killed by endrin applied to the galls for the control of their parents, but applications should preferably not be made when the adults are ready to emerge from the galls, and the value of the sprays is reduced when the plants are in active growth or during heavy rains.

The infestation of a plantation may be very rapid, with the first galls appearing 2–4 weeks after its establishment and all the plants attacked within 20 weeks; the process is less a mass invasion than a rapid increase from individuals that have moved in from the surrounding area. The possibility of preventing such infestations was tested in 1956–58, when sprays of 0·05 per cent. endrin were applied to plants 30 in. high, set in clearings, whenever more than 15 per cent. of the plants were attacked. An adhesive was added to the mixture at the beginning of the test, but was later abandoned as of no value. Eight applications were made in 18 months, by which time the plants had reached an average height of 14 ft. and were considered to be out of danger. Similar results were also obtained when planting was delayed and regeneration had begun in the clearings. Lack of water would preclude the use of sprays in some regions, but soil treatments with dusts or granular formulations might prove effective.

MERTON (L. F. H.). **Studies in the ecology of the Moroccan locust (*Dociostaurus maroccanus* Thunberg) in Cyprus.**—*Anti-Locust Bull.* no. 34, [3 +] 123 pp., 8 pls., 27 figs., 1 fldg. map, 1 fldg. table, 30 refs. London, 1959.

An account is given of some of the results of investigations on the ecology of *Dociostaurus maroccanus* (Thnb.) in Cyprus in 1951–55 [*cf.* also *R.A.E.*, A **40** 194; **47** 10], which were carried out to provide a basis for recommendations for permanent ecological control. A detailed examination of the vegetation of the permanent breeding sites in Cyprus and its relation to other vegetation types there is included. Observations were made on some aspects of the development and behaviour of *D. maroccanus*, and information is given on embryonic development and hatching, the preferred food-plants (grasses) of the adults and hoppers, the effect of various diets on adult fecundity and survival, the distribution of the locusts within the vegetation, the development of gregarious behaviour, the choice of oviposition sites, ovarian development, and the number of eggs per pod. Accounts are also given of observations on the bionomics of the two principal egg predators, *Trichodes laminatus* var. *cyprius* Rttr. and *Systoechus autumnalis* (Pall.). The larvae of these sometimes cause up to 70 or 80 per cent. mortality, but this may be outweighed by favourable conditions for *D. maroccanus* during the early nymphal instars, and a further disadvantage is that neither produces more than one generation a year. Intensity of attack by them is influenced by the presence of certain plants on which the adults feed, and the abundance of some of these is in turn dependent on winter rainfall.

In a discussion of the possibilities of ecological control, the permanent breeding areas are stated to have been derived almost entirely from forests by felling followed by heavy and persistent grazing by sheep and goats. It is therefore desirable to restore a continuous plant cover, and this can be done by cultivation and reseeding, the encouragement of reversion to forest or maquis, or the planting of trees and shrubs. Field trials of some of these methods are in progress. All, however, involve at least some restriction of grazing by semi-nomadic sheep and goats, which provide most of the milk and meat supply of the island and are already at a very low subsistence level. The problem is discussed in relation to current trends in arable and livestock farming and in forestry.

Lloyd (J. H.). **Operational research on preventive control of the red locust (*Nomadacris septemfasciata* Serville) by insecticides.**—*Anti-Locust Bull.* no. 35, [2+] 65 pp., 6 pls., 6 figs., 32 refs. London, 1959.

The following is based on the author's summary. Preventive control of *Nomadacris septemfasciata* (Serv.) in East Africa was first carried out in 1942. The organisation then responsible for the work was too small to be effective, but its results during the following seven years indicated that outbreaks might be prevented by operations in the outbreak areas. In 1949, the International Red Locust Control Service [*R.A.E.*, A **38** 135] was formally established to continue the work of permanent supervision and the prevention of swarm escapes from the outbreak areas. During the next three years there were occasional escapes of swarms in spite of improved scouting and control. Fortunately, these swarms did not initiate any outbreak. There was, however, a growing feeling that the Service was not only failing to ensure adequate preventive control, but also that its cost was higher than had been expected or was justifiable in view of the incomplete results. There were doubts as to whether scouting and control were suitably designed and whether they were operated properly and on an adequate scale. It was suggested that operational research should be undertaken in the hope of discovering effective methods of control that would result in an over-all reduction of costs.

In the present work, the investigations made in 1952–57, mainly in Northern Rhodesia and Tanganyika, on methods of controlling adults and hoppers of *N. septemfasciata* are described. It was found that scouting was totally inadequate for successful control by ground methods, and, moreover, there was no single ground method that could be relied on under all the conditions of an outbreak area. The variety of methods available did not completely offset the unsuitability of individual methods, and in some situations all ground methods were virtually useless. Hopper control methods were given thorough investigation and trial. The best method for general application was a form of hand-dusting with bellows-dusters (puffer-dusting), using BHC. This method can be used more extensively and is less costly than other ground methods, but it cannot be used widely enough and is troublesome to operate. The proven success of aerial spraying against adult locusts led to the decision that hopper control by aircraft should be tried.

Investigations with aircraft were carried out, and it was concluded provisionally that hopper bands were not sufficiently visible to be controlled satisfactorily by direct aerial spraying without ground aid. It seemed, however, that spraying in a lattice pattern with a dieldrin emulsion spray can be developed into a highly effective and economical method for killing

hoppers. In Tanganyika, aircraft were used successfully in 1955 for controlling both settled and flying swarms of adults by spraying with 20 per cent. DNC solution at average rates of 0·7–1·27 gal. per acre, and, during one of the largest upsurges ever recorded in the locust population, virtually all the control was done by aircraft and not a single swarm escaped. The success of aerial spraying was increased by the visibility of swarms from the air, so that they could be sprayed effectively in flight. This lessened the chances of swarms escaping, as they might if reliance had to be placed on ground scouting. Aircraft therefore reduced the need for ground scouting. Although chartered aircraft were used, aerial spraying was less costly than control by ground methods. It seemed that even greater savings and efficiency would be possible if the Service had its own aircraft, and accordingly two light aircraft were bought. It is concluded that the successful use of aircraft for round-the-year control may not only reduce the over-all cost of control but may result also in the Service being completely effective, yet smaller and less expensive.

Graham (W. M.) & Kockum (S.). **Protection of bagged maize with lindane and DDT.**—*Trop. Agriculture* (*Trin.*) **35** no. 4 pp. 292–298, 4 figs. London, 1958.

In a comparison of a dust of γ BHC (lindane) and a spray of DDT for the protection of stored maize in Nairobi, Kenya, 200-lb. bags of maize were built into four stacks, each consisting of 3,080 bags arranged in 20 layers, in a hangar. Each layer in two of the stacks was evenly dusted with 0·5 per cent. γ BHC in diatomite at a rate of 3 oz. per bag surface, and each layer in the other two was sprayed with 1 lb. 50 per cent. wettable DDT in 1 gal. water at a rate of 3 gal. per 1,000 sq. ft.; the floor and dunnage under one of each pair of stacks were heavily dusted with 10 per cent. DDT in diatomite. The stack treatments were equivalent to 4·7 parts γ BHC and 44 parts DDT per million of grain. The stacks were fumigated in April 1956 with methyl bromide at 2·5 lb. per 1,000 cu. ft. to ensure that no living insects were present at the beginning of storage, and the hangar was then closed until April–May 1957, when the stacks were broken down and sampled. There was no untreated stack to provide comparative results. Samples of maize were withdrawn from the centres of nine bags from each of the odd-numbered layers, but none was taken from the sides of stacks adjacent to other stacks, so as to reduce the possible effects of inter-stack influences. With the exception of *Ephestia cautella* (Wlk.), of which there was a medium infestation throughout the stacks, insect populations were light to medium and restricted mainly to the upper layers. Only two living examples of *Sitophilus* (*Calandra*) *oryzae* (L.) were found, and although the routine practice of dusting with 0·5 per cent. γ BHC at 1 oz. per bag may have been partly responsible for the low level of this pest, an unknown factor is suspected of preventing its re-establishment in fumigated grain. *Tribolium castaneum* (Hbst.) and *Oryzaephilus surinamensis* (L.) were the only insects that were at all common. The numbers of *T. castaneum* recorded from the stacks treated with DDT and γ BHC alone and (in brackets) with the floor treatment were 221 (115) and 40 (4), respectively, and those of *O. surinamensis* were 0 (81) and 343 (6). Both stack treatments were considered to have provided good protection for a year, but it was thought that infestation was becoming established when the bags were sampled. *T. castaneum* was controlled significantly more effectively by γ BHC than by DDT, but the results with *O. surinamensis* were less clear, since the latter appeared to prefer a temperature of 26°C. [78·8°F.], and

increases in grain temperature above a normal level were seldom reached when *T. castaneum* was well controlled. The value of the floor treatment was uncertain.

DA SILVA BARBOSA (A. J.). **O complexo de capsídeos do algodoeiro em Moçambique.** [The complex of Mirids on cotton in Mozambique.]—*Bol. Soc. Estud. Moçambique* **27** no. 111 pp. 113–126 [+1]; also as *Mem. Trab. Cent. Invest. cient. algod.* no. 33. Lourenço Marques, 1958. (With a summary in English.)

A list is given of upwards of 16 species of Mirids that infest cotton in Mozambique. The three most important are *Helopeltis schoutedeni* Reut., *Lygus vosseleri* Popp. and *Adelphocoris* (*Megacoelum*) *apicalis* (Reut.), and the bionomics and control of these are reviewed. Complete development from egg to adult lasted 33–55, 25–43 and 25–46 days, respectively, in the laboratory, and the adults were long-lived. Natural enemies are noted; all were predators except *Euphorus* sp., an effective but rare Braconid parasite of *Lygus* and *Adelphocoris*. Dusts of 5 or 10 per cent. DDT, 20 per cent. toxaphene, 2 per cent. γ BHC or a mixture of 5 per cent. DDT, 3 per cent. γ BHC and 40 per cent. sulphur gave good control of all three species, γ BHC alone proving the least effective.

FURMIDGE (C. G. L.). **Physico-chemical studies on agricultural sprays. I. General principles of incorporating surface-active agents as spray supplements.**—*J. Sci. Fd Agric.* **10** no. 5 pp. 267–273, 31 refs. London, 1959. **II. The phytotoxicity of surface-active agents on leaves of apple and plum trees.**—*T.c.* pp. 274–282, 4 figs., 15 refs.

In the first of these papers, the effects produced by the use of surface-active agents as spray supplements are discussed, particularly in relation to the stability of spray fluids, the mechanism of droplet formation, the impaction of droplets and the deposition and retention of material from low- and high-volume sprays. It is pointed out that phytotoxicity due to surface-active agents themselves can be considerable with certain materials, that it is governed by the chemical nature of the agent and that it can vary between different plants in both degree and nature of damage. Some surface-active agents have germicidal, fungicidal or insecticidal effects, the last being apparently related to penetrating power [*cf. R.A.E.*, A **19** 267; **23** 450–452; **26** 286], and these effects should be borne in mind during laboratory tests of the toxicity or formulations of fungicides and insecticides.

The following is based on the author's summary of the second paper. The damage caused to the leaves of several varieties of apple and plum by dipping them for 10–15 seconds in aqueous solutions of anionic, cationic and non-ionic surface-active agents, representing the main types used in sprays, is described. Examination at intervals for about two months showed that it varied with the chemical nature and concentration of the surface-active agent and also with the species of tree; factors that affected it to a more limited extent were the variety and manurial status of the tree, the age of the leaf and the weather conditions. It was found that many of the ionic materials caused considerable leaf damage, particularly cationic materials on plum, but the non-ionic materials were relatively harmless. The damage is considered to result from the disorganisation of the permeable membranes of the cells after the penetration of the surface-active agent through the leaf cuticle. Possible routes for such penetration are discussed.

Proceedings of the Tenth International Congress of Entomology, Montreal, August 17–25, 1956. Section on biological control.—*Proc. 10th int. Congr. Ent.* **4** pp. 441–924. Ottawa, 1958.

The following are abstracts of selected papers containing hitherto unpublished information of which the text is printed in full in this section [*cf. R.A.E.*, A **48** 140, etc.].

Bess (H. A.) & Haramoto (F. H.). **Biological control of pamakani, *Eupatorium adenophorum*, in Hawaii by a Tephritid gall fly, *Procecidochares utilis*. I. The life history of the fly and its effectiveness in the control of the weed,** pp. 543–548, 6 figs., 7 refs. The following is based on the authors' abstract and conclusions. *Eupatorium adenophorum* (*glandulosum*), a plant of tropical America, which was introduced into Hawaii as an ornamental about 1860, spread rapidly to adjacent areas and formed dense thickets up to 10 ft. tall on valuable grazing land. Until 1945, infested ranchland was cleared by mechanical removal of the weed, but *Procecidochares utilis* Stone [*cf.* **37** 81], the bionomics of which are described, was introduced from Mexico in 1945 and gave effective control over many thousands of acres in certain areas by 1955. Ranchers no longer apply control measures there, but the Trypetid has had little influence on the weed in a limited area on the wet, steep slopes on the windward side of East Maui.

The rapid increase and continued high populations of *P. utilis* in the Ulupalakua area on Maui and its comparative scarcity in certain other areas, especially along the Hana Coast of East Maui, prompted a study of the progress of the fly and the reduction of the weed. In many areas, *P. utilis* has been abundant enough to cause many galls per plant during each growing season, weakening them and causing the deaths of many thousands by its sustained attack. As the plants in the thickets are weakened and die, those remaining become smaller and more sparse. The fly persists in sufficient numbers to cause heavy galling and stunting of these isolated plants, which eventually die and leave the land completely free. This has occurred on thousands of acres of grazing land, despite a high degree of parasitism, often exceeding 50 per cent., by *Opius tryoni* Cam., *O. longicaudatus* (Ashm.), *Bracon terryi* (Bridw.), *Eupelmus cushmani* (Crwf.) and *Eurytoma tephritidis* Fullaway.

Fullaway (D. T.). **Biological control of *Opuntia megacantha* and *Lantana camara* in Hawaii,** pp. 549–552. The author describes work leading to the suppression of *Opuntia megacantha* in Hawaii by the introduction of *Cactoblastis cactorum* (Berg), *Dactylopius opuntiae* Ckll. and *Lagochirus funestus* Thoms. [*cf.* **43** 247] and renewed attempts to control *Lantana camara* by means of introduced insects [*cf.* **3** 757; **13** 20; **15** 450]. Of the insects found on *Lantana* in 1953–54 during surveys in the Americas, *Diastema tigris* Gn. from Panama and Florida, *Catabena esula* (Druce) from southern California, *Blepharomastix acutangularis* (Sn.) from Mexico, *Syngamia haemorrhoidalis* (Guér.) from Cuba and Florida, *Teleonemia vanduzeei* Drake from Cuba, *Plagiohammus spinipennis* (Thoms.) and *Aerenicopsis championi* Bates from Mexico and *Octotoma scabripennis* Guér. from Mexico and Honduras are being propagated in the laboratory or have been released. *O. scabripennis*, a Hispid that mines the leaves as a larva and punctures and feeds on them as an adult, is established, and the eventual establishment of most of the others is expected.

van de Vrie (M.) & de Fluiter (H. J.). **Some observations on the effect of insecticides and acaricides on the population of the European red spider mite (*Metatetranychus ulmi* Koch) and its principal predators in commercial orchards in the Netherlands,** pp. 603–606. 7 graphs, 4 refs. The following

is based on the authors' abstract. Observations in 1953–55 on the effects of insecticides and acaricides in sprays on *Panonychus* (*Metatetranychus*) *ulmi* (Koch) and its predators, *Typhlodromus* spp., *Anthocoris nemorum* (L.) and *Orius minutus* (L.), on apple showed that chlorbenside, alone or with DDT, caused a sharp decline in the population of *P. ulmi*, followed by a similar decline in the predacious insects, which are dependent on the numbers of prey, but scarcely affected *Typhlodromus*. The application of chlorbenside or chlorfenson (Ovotran) with parathion resulted in very good control of *P. ulmi*, but also in almost total destruction of the predacious mites and insects. On untreated trees in 1955, *P. ulmi* reached such a high density early in the season that leaf damage occurred despite the presence of predators. Later, the pest declined because of a lack of food, due to severe bronzing of the leaves; at the same time, the predacious insects declined in numbers, but the predacious mites were scarcely affected.

Muma (M. H.). **Predators and parasites of *Citrus* mites in Florida,** pp. 633–647, 14 graphs, 28 refs. The following is based on the author's summary and conclusions. An attempt is made to compare, integrate and evaluate published and unpublished data on the natural control of the five most common and widespread phytophagous mites found on *Citrus* in Florida. Infestation by *Phyllocoptruta oleivora* (Ashm.) is reduced during the late summer and early autumn by the high incidence of an entomogenous fungus that is associated, if not identical, with *Hirsutella thompsonii* [*cf.* **44** 238], the degree and duration of the reduction being directly proportional to mite density. Populations also seem to be directly influenced by temperature and moisture, but the part played by weather in natural control is not fully understood. No predator has been shown to reduce infestations, but the quick recovery and high incidence of the mite after the application of certain insecticides indicates the existence of one.

Infestation by *Panonychus* (*Metatetranychus*) *citri* (McG.) is controlled during periods of high humidity or rainfall by *Entomophthora* sp. [*cf.* **44** 238], the degree and extent of control again being dependent on host density. There is evidence that certain increases in infestation after applications of insecticides and acaricides are at least partly the result of mortality among predacious Phytoseiids, but large predators are probably not important in the natural control of the mite, owing to its small size and inadequacy as food. It is also attacked by a little-known fungus, *Hirsutella* sp.

Infestations by *Eotetranychus sexmaculatus* (Ril.) vary from year to year in intensity and duration according to the temperatures during the preceding December; low temperatures produce heavier, more prolonged spring infestations than do high ones. Predators, particularly *Typhlodromus floridanus* Muma, seem to reduce poulations to non-economic levels by about mid-May each year; this reduction appears to be independent of December temperatures and intensity of mite infestation, and to be related to high spring temperatures and increased rainfall. A fungus disease is known to exist, but has not recently been common enough to evaluate. *Eutetranychus banksi* (McG.) is controlled during the wet summer months by a natural enemy, probably a species of *Entomophthora* that is known to attack it. Infestations by *Brevipalpus phoenicis* (Geijskes) undergo cycles of high and low intensity. As they do not decrease in periods of high humidity or rainfall, a complex of predacious Phytoseiids, rather than disease, is believed to cause the reductions.

Anderson (N. H.) & Morgan (C. V. G.). **The role of *Typhlodromus* spp. (Acarina: Phytoseiidae) in British Columbia apple orchards,** pp. 659–665, 3 graphs, 15 refs. The following is substantially the authors' abstract. The family Phytoseiidae is represented by at least 30 species of *Typhlodromus*

and *Phytoseius* in southern British Columbia; most of them occur widely but in relatively small numbers. *T. rhenanus* (Oudm.), *T. occidentalis* Nesbitt and *P. macropilis* (Banks) are the common species in commercial orchards. The distribution of these three mites on the leaves indicates that they are not very efficient predators; they occur on the lower surface, primarily along the midrib, whereas most of the mites on which they prey feed on both surfaces and have a more random distribution. *Typhlodromus* spp. do not produce such large populations as the phytophagous mites, because they have fewer generations a year, a lower rate of egg production and a higher winter mortality. By using the colour of ingested food as an indicator of the mite consumed, it was found that *T. occidentalis* and *T. rhenanus* fed only sparingly on *Panonychus* (*Metatetranychus*) *ulmi* (Koch) or *Bryobia* spp. They fed chiefly on free-living Eriophyids, but were not observed to control infestations in commercial orchards. However, they may be of some value in limiting the numbers of *Tetranychus telarius* (L.) and *Eotetranychus carpini borealis* (Ewing).

Putman (W. L.) & Herne (D. C.). **Natural control of phytophagous mites (Tetranychidae and Eriophyidae) in Ontario peach orchards,** pp. 667–673, 9 refs. The following is virtually the authors' abstract. Among at least 28 species of predators attacking *Panonychus* (*Metatetranychus*) *ulmi* (Koch) in peach orchards in Ontario, *Typhlodromus rhenanus* (Oudm.), *Stethorus punctillum* Weise and *Haplothrips faurei* Hood are the most important; *Chrysopa plorabunda* Fitch and *C. rufilabris* Burm. may occasionally have some effect. Most species are relatively scarce in spring and seldom reach effective numbers until some time in August and September, after the natural decline of *P. ulmi*. *S. punctillum* and *H. faurei* have been greatly reduced, even in unsprayed orchards, since DDT and parathion came into use in the district, but populations of *P. ulmi* have remained very low in some orchards not receiving insecticides, where other predators are also scarce; this throws doubt on the importance of predators in natural control, but the results are not yet conclusive.

Most of the predacious species also attack *Tetranychus telarius* (L.), which is especially susceptible, owing to its habit of living in colonies, although weather factors are probably equally important in control. Predators of *Bryobia practiosa* Koch are fewer, and *T. rhenanus* and other Phytoseiids are the only common predators of *Aculus* (*Vasates*) *cornutus* (Banks).

Heimpel (A. M.) & Angus (T. A.). **Recent advances in the knowledge of some bacterial pathogens of insects,** pp. 711–722, 1 graph, 74 refs. The following is substantially the authors' abstract. Recent investigations in North America and Europe on bacteria of the group of *Bacillus cereus* as pathogens of insects are reviewed. It has been shown that the bacteria can be separated into two types. One produces crystalline inclusions in sporulated cultures, and a proteinaceous compound, toxic to insects and apparently associated with the crystalline inclusions, has been isolated from such cultures. The other does not form crystalline inclusions, but produces a toxic enzyme that breaks down tissue phospholipids. Studies on mode of action have shown that these toxic substances can cause the death of certain species of insects; the possibility that other factors contribute to virulence is discussed. Laboratory and field feeding tests are reported, and the implications of the histopathology and interactions of the host and parasite in these diseases are considered.

Franz (J. M.). **The effectiveness of predators and food in limiting gradations of** *Adelges* (*Dreyfusia*) *piceae* **(Ratz.) in Europe,** pp. 781–787, 5 figs., 7 refs. The following is based on the author's abstract. The effect of predators on infestation of fir trees (*Abies alba*) by *Chermes* (*Adelges*)

piceae Ratz. in Germany was determined by comparing aphid populations on patches of bark from which predators were excluded with those on unprotected patches; recording the position of each aphid throughout its life by means of a five-fold pantograph and analysing serial photographs provided detailed information on the fate of many thousands of insects. Native predators [*cf.* **46** 246, etc.] caused very high mortality, mainly in spring, but also in autumn, under suitable meteorological conditions, and sometimes destroyed an infestation on a single tree or group of trees. The degradation of the phellogen and phelloderm cells after heavy infestation for several years also prevented permanent infestation [*cf.* **48** 271], and the relative effect of predators and bark damage was therefore evaluated. Bark that was kept free of predators was heavily infested for one year after the disappearance of the aphids from the rest of the trunk, but the protected population later declined. At the same time, a secondary phellogen appeared in the deeper layers of the bark. It appears, therefore, that the two factors act independently, bark damage reducing aphid populations later and more slowly than attack by predators. The combined effect of these and other factors of more restricted importance is the termination of an outbreak after a few years of heavy infestation.

Wylie (H. G.). *Adelges nüsslini* (**Börner**) (**Homoptera: Phylloxeridae**) **and its predators in eastern France,** pp. 789–793, 15 refs. The following is substantially the author's abstract. The life-history of *Chermes nordmannianae* Eckstein (*Adelges nüsslini* (Börner)) in the Vosges Mountains of eastern France is described and compared with that recorded for other parts of Europe [*cf.* **48** 270]. The insect infests the twigs of small firs (*Abies alba*) and, less frequently, the trunks of old ones; the effects of infestation are described. The predators observed were *Aphidecta obliterata* (L.), *Scymnus* (*Pullus*) *impexus* Muls., *Anatis ocellata* (L.), *Exochomus quadripustulatus* (L.), *Laricobius erichsonii* Rosenh., *Chrysopa ventralis* Curt., *Leucopis griseola* (Fall.), *L.* (*Neoleucopis*) *obscura* Hal. and *Syrphus arcuatus* (Fall.) [*cf.* **46** 246–247]. Notes on their life-histories are given, observations on their selection of habitat are recorded, and the significance of this in evaluating the effect of each as a biological agent of control is discussed.

Pschorn-Walcher (H.) & Kraus (M.). **Notes on the predators of** *Adelges piceae* **Ratz. and** *A. nüsslini* **C.B. (Hemiptera; Adelgidae) in Sweden,** pp. 797–799, 4 refs. The following is substantially the authors' abstract. In connection with the long-term programme of biological control of *Chermes* (*Adelges*) *piceae* Ratz. in Canada, the collection of predators was recently extended to Sweden, and a report is given on the predator fauna in that country, which is compared with the complex in central Europe [*cf.* **46** 246]. While some important species, such as *Laricobius erichsonii* Rosenh. and *Scymnus* (*Pullus*) *impexus* Muls., were absent from plantations of fir (*Abies alba*) and others, such as *Cremifania nigrocellulata* Czerny and *Aphidoletes thompsoni* Möhn comparatively rare, *Aphidecta obliterata* (L.) and an unidentified species of *Syrphus*, both associated mainly with *Chermes nordmannianae* Eckstein (*Adelges nüsslini* (Börner)), were more abundant and offer greater chances for collection in Sweden than in central Europe.

Dowden (P. B.) & Crosby (D.). **The present status of the balsam woolly aphid in the United States,** pp. 823–825. The following is substantially the authors' abstract. Balsam fir (*Abies balsamea*) suffers heavy mortality from *Chermes piceae* Ratz. in Maine, New Hampshire and Vermont. Surveys in the Green Mountain National Forest in 1956 indicated that about 75 per cent. of the merchantable timber was infested in the affected areas and that 21 per cent. of it had been killed within the previous five years. Comparable figures for affected areas in the White Mountain

National Forest were 50 per cent. of the trees infested and 8 per cent. killed. In Maine, trunk attack has killed much of the older fir in Washington and Hancock Counties, and the annual loss in affected areas is probably 10–20 per cent. On the coast, the gout type of injury [*cf.* **42** 263] is most prevalent, and infested trees rarely reach merchantable size. The important predator, *Leucopis obscura* Hal., has spread naturally from New Brunswick throughout Maine and is now being colonised in the rest of the region. Colonies of *Scymnus* (*Pullus*) *impexus* Muls. and *Laricobius erichsonii* Rosenh. were released in 1955, and *Laricobius* has been recovered in southern Vermont.

C. piceae has been killing grand fir (*A. grandis*) in the Willamette Valley of Oregon since about 1930. Surveys in 1954 and 1955 showed serious infestations on silver fir (*A. amabilis*) in both Oregon and Washington; almost 300,000 acres were affected, and about 57,000 heavily infested [*cf.* **48** 188, etc.].

Abarca (M.), Cortés Iturbe (A.) & Flores Caceres (S.). **The sugarcane borers in Mexico. An attempt to control them through parasites,** pp. 827–834, 5 figs., 16 refs. The following is based on the authors' abstract. A brief account is given of investigations, carried out in 1951–56 in the north-western and north-eastern coastal plains of Mexico, on the possibility of controlling sugar-cane borers by means of their natural enemies. *Diatraea considerata* Heinr., *Zeadiatraea* (*D.*) *grandiosella* (Dyar) and *Chilo loftini* Dyar in the north-west and *D. saccharalis* (F.) and *D. magnifactella* Dyar in the north-east are believed to cause heavy losses [*cf.* **43** 220–221], and one or more of them have been experimentally parasitised by *Paratheresia claripalpis* (Wulp), *Zenillia* (*Palpozenillia*) *palpalis* Aldr., *Lixophaga diatraeae* (Tns.) or, to a smaller extent, *Metagonistylum minense* Tns. The ecological conditions of the areas, the life-history of the borers and the preliminary results obtained from releases are outlined. In general, the work was less successful than expected, owing to seasonal and daily variation of temperature and humidity, and especially to the high temperatures of summer. The parasites can be reared only in the spring, but the host population does not increase until the summer; weekly mean temperatures of less than 20°C. [68°F.] or more than 30°C. [86°F.] check parasite development in the laboratory and reduce it considerably in the field, and the established custom of burning cane before harvesting prevents continuity of parasitism.

Tadić (M. D.). *Apanteles hyphantriae* **Riley, an egg parasite of the fall webworm,** pp. 859–861, 3 figs., 6 refs. The following is substantially the author's abstract. In the course of work on the biological control of. *Hyphantria cunea* (Dru.) in Yugoslavia in 1953–56 [*cf.* **45** 331], *Apanteles hyphantriae* Ril. was introduced from Canada, and its biology was investigated in the laboratory at Zemun. Tests over a period of three years showed that it attacks the eggs of *H. cunea*. The adults pair immediately after emergence, and the females oviposit 5–6 days later, at temperatures of 20–25°C. [68–77°F.]. The eggs are laid in those of the host and hatch in about 48 hours, before the host egg hatches, and the complete development of the parasite in the host egg and larva lasts 26 days.

Mashhood Alam (S.). **Life-cycle and host-parasite relationship in the field and the larval anatomy of** *Metaphycus taxi* **Alam,** pp. 879–887, 13 figs., 10 refs. The author records the occurrence together of *Aphycus* (*Metaphycus*) *taxi* (Mashd. Alam) and *Coccophagus taxi* Mashd. Alam as endoparasites of *Eulecanium taxi* Habib on yew (*Taxus baccata*) in southern England [*cf.* **46** 25] and describes the differing morphology and bionomics of the two annual generations of *M. taxi*.

Iyatomi (K.). **Effect of superparasitism on reproduction of** *Trichogramma*

japonicum **Ashmead,** pp. 897–899, 3 graphs, 4 refs. The following is based on the author's abstract. *Trichogramma japonicum* Ashm. is one of the most important natural enemies of *Chilo suppressalis* (Wlk.) on rice in Japan, sometimes parasitising 50 per cent. of the eggs in the field. In tests, the number of hosts attacked in a fixed population increased rapidly with initial increase in the number of parasite eggs deposited, but more slowly with a further increase in parasites. As parasitism increased, the percentage of simple parasitism (eggs attacked once only) reached a maximum and then decreased, whereas that of superparasitism increased steadily; the highest percentage of simple parasitism was 58·2, when total parasitism was 83·5 per cent. As the density of parasites in a fixed population of hosts increased, superparasitism increased, resulting in a decrease in mean body length, rate of emergence, proportion of females (because of the dominance of males over females in competition) and average number of eggs per female among the parasites and in imperfect development of some of these on emergence. There is, therefore, an optimum degree of parasitism, estimated to be about 84 per cent., for maximum reproduction of *Trichogramma*.

Delucchi (V. L.). *Lithocolletis messaniella* **Zeller (Lep. Gracilariidae): analysis of some mortality factors with particular reference to its parasite complex.**—*Entomophaga* **3** no. 3 pp. 203–270, 20 figs., 50 refs. Paris, 1958. (With a summary in German.)

Lithocolletis messaniella Zell., which mines the leaves of broad-leaved trees, is of no economic importance in Europe, where its distribution probably coincides with those of *Quercus suber* and *Q. ilex*, its winter food-plants, but it is becoming a serious pest in New Zealand, where it was first observed in 1951 [*cf. R.A.E.*, A **43** 234, 363] and appears to be spreading rapidly. It attacks a wide range of evergreens there in winter, but *Q. suber* and *Q. ilex* are probably the only ones permitting complete development; in summer, full development occurs on many deciduous plants, in contrast to the much narrower range of deciduous oaks, chestnut and occasionally hornbeam in Europe, and this adaptation and the lack of a parasite complex seem to account for its greater importance.

Investigations in the prealpine regions of Switzerland and Italy in 1955–57 showed that *L. messaniella* passed through two winter generations on *Q. suber* and *Q. ilex* between November and April and that some adults of the second migrated to deciduous oaks and hornbeam when these produced leaves towards the end of April. The spring generation developed on either the evergreen or the deciduous trees, and 2–3 summer generations were produced on deciduous trees; the last of these was small and largely confined to chestnut. There was one more generation in the Mediterranean region. The larvae generally pass through six instars, feeding on the sap in the first four and on the leaf tissue in the last two. Pupation takes place in a cocoon in the mine, and the adults live for up to two months or more. Low temperatures in winter and wind and hail storms during the rest of the year were found to reduce infestation considerably, and there was much mortality during adult migration, particularly in autumn. The winter larvae were sometimes killed by the formation of necrotic cells round the mines, as a reaction of the leaf tissue to feeding, and they were parasitised by *Apanteles circumscriptus* (Nees) and to a less extent by *Sympiesis sericicornis* (Nees). The spring and early summer generations were parasitised by *Achrysocharis formosa* (Westw.), *Tetrastichus xanthops* (Ratz.), *Cirrospilus* (*Atoposomoidae*) *unifasciatus* (Forst.) and other species of this genus, and the last summer generation by *Enaysma splendens*

Delucchi, *Pediobius linus* (Wlk.) and sometimes *C. unifasciatus*. Nine other Eulophids and an Encyrtid of less importance were also reared from *L. messaniella*. Few of the species act only as primary parasites, but primary parasitism prevails. *Mesochorus convexicollis* Thoms. and *Gelis* sp. were reared only as hyperparasites, attacking *Apanteles*. The relations of the parasite complexes attacking each generation of *L. messaniella* are discussed in some detail, and a key is given for the identification of the parasites, with notes on their taxonomy and bionomics.

As a result of these investigations, *A. circumscriptus* and *E. splendens* were sent to New Zealand for trial against *L. messaniella* there, and it is suggested that if these become established, the parasite complex could be increased by mass rearing and distribution of some of the others, in spite of their hyperparasitic tendency.

Steffan (J. R.). *Brachymeria* (**Hym. Chalcididae**) **parasites de** *Anomis flava* **F. à Madagascar.**—*Entomophaga* **3** no. 3 pp. 275–280, 8 figs., 1 ref. Paris, 1958. (With a summary in English.)

Two species of *Brachymeria* were found parasitising the pupae of *Cosmophila* (*Anomis*) *flava* (F.) on cotton in Madagascar, *B. multicolor* (Kieff.), which was rare and the adults of which are redescribed, and *B. tibialis*, sp.n., which gave important control and is described from adults of both sexes. Two varieties of the latter are distinguished, the typical one, which was also reared from various unidentified Noctuids and Pyralids, and var. *stigmosa*, n.

Féron (M.) & Guennelon (G.). **Recherche d'éléments écologiques en vue de la lutte contre la cécidomyie des lavandes** (*Thomasiniana lavandulae* **Barnes).**—*Ann. Epiphyt.* **9** no. 1 pp. 11–26, 4 figs., 8 refs. Paris, 1958.

The ecology and bionomics of *Thomasiniana lavandulae* Barnes were studied in Vaucluse and Drôme in 1956–57 to ascertain the best methods for the control of this Cecidomyiid on cultivated lavender [*cf. R.A.E.*, A **47** 153, etc.], which comprises both true lavender [*Lavandula vera*] and hybrids of it. The larvae live beneath the bark, where they cause a local necrosis, followed by foliar discoloration and wilting of the entire shoot. The appearance and severity of the symptoms on individual plants depend on the density of the population and its distribution on a shoot, the position of infested shoots on a plant in relation to insolation and prevailing winds, and the date of hatching. The severity of attack is influenced by the vigour, age and variety of the lavender, its exposure and the altitude at which it is grown. Plants of all ages were found to be liable to infestation, but older plants suffered the greatest injury; on one plantation of hybrid lavender, the percentages of one-, five- and ten-year-old clumps attacked were 3, 55 and almost 100, respectively, and on another the numbers of adults that emerged in 1957 from the soil beneath individual plants of one variety aged four, five and ten years averaged 20, 43 and 55, respectively. From counts made on two plantations, it was evident that plants were generally infested continuously after an initial attack, and reasons suggested for the preference for aging plants include the increased shelter provided by them during the winter and the rugged nature of the bark, which affords numerous oviposition sites. The spread of infestation in a plantation did not follow a regular pattern from existing foci, and plantations on mountain slopes facing south and sheltered from the wind sustained most damage.

Eggs are laid at the base of the lavender stems, especially in crevices of

the old bark where the stem bifurcates, about an inch above the soil surface, and are difficult to reach with contact insecticides. They were obtained in the laboratory by confining adults in tubes with a piece of lavender stem on which a patch of bark had been raised at one edge, and were usually laid in the crevice so formed. Larval development was difficult to follow, but the larvae moved little during the feeding phase. Larvae of different ages were found together in single stems examined between 15th March and 15th July. From early June, they migrate to the soil, and most leave the stems within a month, although at an altitude of about 2,600 ft. some larvae were still found in stems at the end of August. Control of the larvae, except by the use of systemic insecticides, which might have an adverse effect on the aromatic constituents of the flowers, appeared to be confined to treatments coinciding with this migration to the soil, but the migrating larvae are protected by the density of the vegetation and a material with pronounced persistence would be required to give mortality over the whole migration period. The pupae occur in cocoons in the upper soil, and treatments against them are considered impracticable. The adults are vulnerable, however, although they lived for only 2–6 days at 2,600 ft. in March and the females oviposited within 48 hours of emergence. There were peaks of emergence in the last week of February and the second week of March, but emergence was generally continuous from late February to early April, as measured by the numbers of adults collected in box traps.

A tentative field test on control was carried out in a plantation of five-year-old hybrid lavender facing north. Dusts containing 10 per cent. DDT or 1·25 per cent. endrin were applied on 28th February or 5th March, 8th March (after heavy rain) and 18th and 27th March, at rates of 27–31·5 lb. per acre. The first application was probably too late, in respect to adult emergence, and the percentage attack was 28·2 for DDT, 43·2 for endrin, and 56·6 on untreated plots.

Chaboussou (F.). **État actuel de la lutte chimique contre les tétranyques nuisibles aux arbres fruitiers en Europe.**—*Ann. Epiphyt.* **9** no. 1 pp. 77–93, 89 refs. Paris, 1958.

In this review of recent literature on the use of chemicals against Tetranychids on fruit trees in Europe, particular attention is paid to *Panonychus* (*Metatetranychus*) *ulmi* (Koch), *Tetranychus telarius* (L.) (*urticae* Koch), *T.* (*Amphitetranychus*) *viennensis* Zacher, which has recently occurred on apple in France, and species of the complex of *Bryobia praetiosa* Koch and to the effects of insecticides, fungicides and other materials on population equilibrium and outbreaks of Tetranychids. It is concluded that the difficulties of timing the application of contact sprays are such that, although the use of parathion in oil emulsion [*cf. R.A.E.*, A **48** 109, etc.] as a general ovicide is of considerable value, systemic materials such as methyl-demeton or endothion that are harmless to predacious insects provide the method of choice. Should measures need to be taken within a month of harvest, the use of quick-acting contact poisons such as diazinon or chlorfenson is recommended.

Lüders (W.). **Engerlingsbekämpfung mit betriebseigenen Mitteln.** [Control of *Melolontha* larvae with farm implements.]—*Z. angew. Ent.* **42** pt. 1 pp. 1–88, 42 figs., 32 refs. Hamburg, 1958.

An account is given of investigations carried out in 1952–54 near Stuttgart to determine the mortality of larvae of *Melolontha* resulting from the use

of various agricultural implements for tilling the soil after harvest, when most of the larvae are fairly near the surface; it is preceded by a short section on cultural methods of control. The results are given in detail separately for each implement, and include the mortality of the different instars above and below the surface of the soil and the effects of using the implement one or more times, varying its relative direction of movement each time, and using an additional implement in conjunction with the one tested. Many of the implements, including various ploughs, hoes and harrows, gave satisfactory control of first-instar larvae when used once only, and these can therefore be controlled by the normal soil treatments that follow the harvest, but satisfactory control of second- and third-instar larvae was obtained only with disk-harrows, a rotary cultivator and one of the rotary hoes tested, all of which had to be used more than once to obtain the required effect. Mortality obtained with some implements was increased when a heavy harrow was later used in the field twice, in a criss-cross pattern. Observations on a root crop planted in fields cultivated earlier showed that the measures taken reduced damage and increased yield, and it is concluded that the use of these implements should replace that of insecticides whenever possible.

RÖMER (D.). **Über die Wirkungsweise neuer Insektizide der Indengruppe.** [On the mode of action of new insecticides of the indene group.]—*Z. angew. Ent.* **42** pt. 1 pp. 89–124, 13 graphs, 3 pp. refs. Hamburg, 1958. (With a summary in English.)

The tests described were carried out in the laboratory to determine the effectiveness of Hostatox (polychloroendomethylenetetrahydroindene), also referred to as HDP, when applied in various ways to adults of *Periplaneta americana* (L.), *Leptinotarsa decemlineata* (Say) and *Locusta migratoria migratorioides* (R. & F.).

The main stomach- and contact-poison tests were carried out at a temperature of 22–23°C. [71·6–73·4°F.], and the results were estimated after 21 and 14 days, respectively. In the stomach-poison tests, which were carried out by methods previously recorded [*R.A.E.*, A **48** 96], *Periplaneta* was treated *per os* with a 60 per cent. Hostatox emulsion concentrate diluted in water or a solution of the purified chemical in groundnut oil and the purified chemical was administered in leaf-sandwiches to *Leptinotarsa*. The symptoms are described and were the same in all tests; insects showing symptoms invariably died. Hyperactivity of *Periplaneta* began after 10–12 hours, followed later by cessation of feeding and non-coordination. The period between knockdown and death was usually 1–2 days, and mortality was considerably more rapid for males than for females. The LD50's and (in brackets) LD100's in mg. toxicant per kg. body weight (the method of calculating which is described) were 30·87 (50) for purified Hostatox and 29 (50) for the concentrate. Mortality of control insects treated with groundnut oil and the emulsifier only was 10 and 8 per cent., respectively. For *Leptinotarsa*, the LD50 and LD100 were 5·75 and 8·25 mg. per kg., and mortality of control insects, which were given potato leaves treated with starch paste and acetone only, was 2–3 per cent. In the contact-poison tests, purified Hostatox in acetone solution was applied to various points of the body of *Periplaneta* or to the tarsi of *Leptinotarsa* and *Locusta*, and their mouth-parts were sealed. The first symptoms in *Periplaneta* appeared after a minimum of 2·5–3 hours, and death ensued in a minimum of 1·5–2 days. The LD50's and (in brackets) LD100's in mg. per kg. body weight were 10·13 (23·75), 15 (25), 12·88 (31·25), 16·24 (32·5), 17·5 (62·5) and

18·13 (62·5) for application to the sternites, tarsi, elytra, wings, antennae and cerci, respectively. Mortality of control insects, which, as in the other contact tests, were treated with an equivalent amount of acetone and had their mouth-parts sealed, was 6 per cent. For *Leptinotarsa*, the LD50 and LD100 were 11·33 and 29·7 mg., respectively, and mortality of control insects was 4 per cent. For *Locusta*, the LD50's and (in brackets) the LD100's were 7 (12·8) mg. for males and 7·4 (12·1) mg. for females, and mortality of control insects was 5 per cent.

In fumigant tests with *Periplaneta*, in which other synthetic insecticides were included for comparison, a solution of the insecticide in acetone was dropped on to filter paper in a rearing jar and, when the acetone had evaporated, another jar with gauze over its open end, containing the test insect, was inverted over it and the two vessels sealed together. The tests were carried out at 32°C. [89·6°F.] and lasted for up to 10 days. Sublimation of the insecticide took place on the walls of both jars, which complicated the results, and the LD50's and (in brackets) LD100's in mg. insecticide per cu. m. space were 39 (134·3) for purified Hostatox, 39 (130·1) for technical Hostatox, 117·1 (162·6) for chlordane and 55·3 (68·3) for γ BHC (lindane). In control tests, adults of *Musca domestica* L. placed in the jars after completion of the tests with *Periplaneta* showed symptoms of contact poisoning. When adults of *Periplaneta* were kept under exactly the same conditions as those treated but without the use of an insecticide, mortality was only 2 per cent.

To investigate the effect of temperature on the action of purified Hostatox used as a contact or stomach poison against *Periplaneta*, further tests using the same methods and otherwise the same conditions as those adopted previously were carried out at 22 and 32°C., and the insects were treated with amounts of insecticide equivalent to the LD50's at the lower temperature. In the contact test, the insecticide was applied on the sternites. The mortality percentages in these and the stomach-poison tests were 50 in each case at 22°C. but rose to 95 and 100, respectively, at 32°C.

Detailed investigations on the mode of action of Hostatox on *Periplaneta* are described and the following is based on the author's summary of the results. After contact poisoning, the thoracic ganglion and the supra- and suboesophageal ganglia were affected. Tests on the supraoesophageal ganglion of treated insects showed that neither cytochromeoxydase nor succinic acid dehydrogenase activity was inhibited and that there was no stimulation or inhibition of cholinesterase activity, but that there was a 30 per cent. reduction in alkaline phosphatase activity after administration of 0·04 mg. purified Hostatox per insect in olive oil.

Klomp (H.). **On the synchronization of the generations of the Tachinid *Carcelia obesa* Zett. (= *rutilla* B.B.) and its host *Bupalus piniarius* L.** —*Z. angew. Ent.* **42** pt. 2 pp. 210–217, 6 figs., 17 refs. Hamburg, 1958. (With a summary in German.)

Investigations in Holland on parasitism of *Bupalus piniarius* (L.) and other Geometrids on pine by *Carcelia obesa* (Zett.) [*cf. R.A.E.*, A **45** 328] showed that, at an abnormally high temperature (24°C. [75·2°F.]), the development of the parasite was no more accelerated than that of *Bupalus* and synchronisation of the two remained undisturbed. Since a delay in the development of the parasite in relation to that of *Bupalus* would also have little effect on their synchronisation, suitable host larvae being available at least until the end of September, it is concluded that climatic factors

do not much affect parasitism by this Tachinid. The overwintered first-instar larvae of the parasite appear to be activated when the overwintered host pupae resume development in spring, and analogous conditions obtain with other hosts of the Tachinid, the life-cycles being synchronised in this way.

Zech (E.). **Untersuchungen über die Entwicklung der Larve des Apfelwicklers** (*Carpocapsa* (*Cydia*) *pomonella* **L.) an Zwetschen und Pflaumen.** [Investigations on the development of the larva of *Cydia pomonella* on damsons and plums.]—*Z. angew. Ent.* **42** pt. 2 pp. 218–230, 4 figs., 16 refs. Hamburg, 1958. (With a summary in English.)

Infestation of stone fruits by *Cydia* (*Carpocapsa*) *pomonella* (L.) independently of its normal food-plants has occasionally been reported [*cf. R.A.E.*, A **29** 415, etc.], but not from Germany. Investigations were therefore carried out at Naumburg, near Leipzig, in 1953–55, to determine whether some of the damage to damsons and plums thought to be caused by other insects was in fact caused by *C. pomonella*. A preference for apple rather than damson for oviposition could not be established in the laboratory, but no eggs and only very few larvae were found (the latter mainly near apple or pear trees) on damson or plum in the open. Larvae developing from eggs placed either on twigs of damson in the field or on twigs or leaves of damson in the laboratory moved to the fruits and bored into them, and few fed on the leaves. Many of the larvae that entered damsons on artificially infested trees were killed by the exuding gum, and most of the infested fruits fell and dried out, so that the remaining larvae developed slowly and few if any adults emerged. In the laboratory, the larvae entered damsons almost as readily as apples. Mortality in plums and damsons was rather high, many of the older larvae were killed by a watery condition of the fruits caused by their feeding and few adults emerged, the females being of low fecundity. Fifth-instar larvae reared on either fruit weighed less than those reared on apples. Only a small proportion of the larvae reared on the leaves of damson gave rise to adults, and it is concluded that damson and plum are of no importance as food-plants of *C. pomonella* in central Germany.

Thalenhorst (W.). **Zur Kenntnis der Fichtenblattwespen. V. Die Populationsdichte der Nematini: Niveau und Fluktuationen.** [Contributions to knowledge of the spruce sawflies. V. The population density of the Nematini: level and fluctuations.]—*Z. PflKrankh.* **65** pt. 10 pp. 577–591, 4 figs., 23 refs. Stuttgart, 1958. (With a summary in English.)

In this further part of a series [*cf. R.A.E.*, A **46** 398, etc.], the results are given of investigations on the population levels of the Nematine sawflies on spruce in a locality in the southern Harz region of Germany [*cf.* **42** 183] in 1950–57 and in others near Göttingen in 1953–57, in which eggs, larvae, pupae and adults were collected in various ways and the populations compared. The stands consisted almost entirely of spruce, and the sawflies were at normal population levels. Analysis of the results showed that *Pachynematus scutellatus* (Htg.), *P. montanus* (Zadd.), *P. pallescens* (Htg.), *Pristiphora saxeseni* (Htg.), *P. compressa* (Htg.) and *P. ambigua* (Fall.), which were all taken in both districts, each comprised, on the average, at least 5 per cent. of all Nematines. Their numbers fluctuated

considerably, and *Pachynematus montanus*, *Pristiphora ambigua* and *P. saxeseni* were more and *Pachynematus pallescens* less numerous in the Harz than near Göttingen. In the Harz, numbers of *P. scutellatus* fell from a high level in 1951 to a low level in 1953–54 and rose again to a high level in 1956, whereas those of *P. montanus* fell and those of *Pristiphora compressa* rose throughout the period. Numbers of larvae of these last two were estimated to average at most 32–40 and those of *Pachynematus scutellatus* 16–20 per tree. Two further species taken in both districts, *P. nigriceps* (Htg.) and *Pristiphora leucopodia* (Htg.), each comprised an average of 2–5 per cent. of the population, their numbers fluctuating somewhat. *Pachynematus* (*Nematus*) *insignis* (Htg.) and *Pristiphora pallida* (Kon.), which was taken only near Göttingen, in 1957, each comprised an average of less than 1 per cent. of the population. A few individuals of *Pachynematus styx* Benson [*cf.* **46** 302] were also observed in the Harz.

Rademacher (B.) & Schwarz (R.). **Die Rotblättrigkeit oder Blattröte des Hafers—eine Viruskrankheit** (*Hordeumvirus nanescens*). [Red-leaf or leaf-reddening of oats—a virus disease.]—*Z. PflKrankh.* **65** pt. 11 pp. 641–650, 5 figs., 6 refs. Stuttgart, 1958. (With a summary in English.)

The following is based on the authors' summary. A virus causing a condition of oats recorded in Germany in 1932 as red-leaf has been found to be identical with that of barley yellow dwarf [*cf. R.A.E.*, A **46** 18]. The most important symptoms on oats are a yellowish or carmine discoloration of the leaves, blasting of florets and stunting of the plants, and yellowing of the leaves and stunting are caused on barley. The symptoms on *Lolium multiflorum* resembled those on oats. In experiments, the virus was transmitted between oats and barley by *Rhopalosiphum padi* (L.) and from oats to oats by *Macrosiphum* (*Metopolophium*) *dirhodum* (Wlk.), both of which are known to transmit it in the United States [*cf.* **43** 268]. The disease is most severe at the edges of fields, in early-infected crops and in incomplete stands.

Eurygaster integriceps **Put.** [*In Russian.*]—*Trud. vsesoyuz. Inst. Zashch. Rast.* **9,** 371 pp., illus., refs. Stavropol, 1958.

The papers in this special volume, all in Russian, are devoted to *Eurygaster integriceps* Put. and abstracts of them appear below.

Shumakov (E. M.). **The problem of the control of** *E. integriceps* **in the USSR,** pp. 3–18, 42 refs. *E. integriceps* has become one of the most important pests of cereals, particularly wheat, in the Soviet Union in the last 20 years, and its control is a serious economic problem. Research on it [*cf. R.A.E.*, A **46** 8–10, etc.] has been carried out in various regions, especially with regard to the use of insecticides, the forecasting of outbreaks, the value of insect parasites, and the effect of early harvesting in reducing the population, and the results are briefly reviewed in this introductory paper, largely from published accounts, and supplemented by reference to similar work in other countries, notably Turkey [*cf.* **44** 44, etc.].

Shumakov (E. M.) & Vinogradova (N. M.). **The ecology of** *E. integriceps*, pp. 19–71, 4 pls., 5 graphs, 38 refs. The ecology and development of *E. integriceps* were investigated in 1950–55 in the regions of Krasnodar, Stavropol and Saratov, and the following is based on the authors' summary of the results of the work, which is described in detail. The dates of migration of the bugs from the woods and mountain sites in which they overwinter can be determined fairly accurately from an analysis of local

conditions and air temperatures in spring. A constant rise in temperature to a daily average of more than 10°C. [50°F.] indicates the approach of migration, and a prolonged anticyclonic period with average daily temperatures above 12°C. [53·6°F.] and average maximum temperature for a five-day period of more than 20°C. [68°F.] indicates the beginning of mass flight.

The dates of initial and mass oviposition in grain fields can be determined by systematic dissection of females, beginning with the onset of mass flight, or by direct counts of eggs in the field. For estimation of the effective numbers of the new generation, the duration of the whole oviposition period or even that of mass oviposition is of little importance, but only that part of it which is not influenced by parasites, the so-called period of ' active oviposition '. The duration of this period and the intensity of reproduction during it permit some estimate of the threat to the crop and of the period over which nymphs will be present and chemical control measures required.

The sum of effective temperatures can be used to obtain an approximate indication of the duration of development. The threshold of development is 10°C., and the sum of effective temperatures is 95 day-degrees C. [171°F.] for the egg, and 375 and 285 day-degrees C. [675 and 513°F.] for the nymphal stage at average daily temperatures below and above 20°C., respectively. Hatching of the nymphs has no relation to ear formation or the flowering period of cereals, as has been suggested by some workers.

The date of harvesting and the methods employed have a considerable effect on the survival and increase in numbers of the bug, since both nymphs and adults can feed not only on the young ears, but also on fully ripe grain, and can complete their feeding on it after cutting. The period between hatching and adult emergence, which is determined by the duration of the period of ' active oviposition ', varies so as to bring about a coincidence of emergence and grain maturity, which is one of the most significant adaptations of the bug as a pest of grain crops.

Investigations on the rate of accumulation and loss of fat reserves showed that the first 10–15 days after adult emergence is the most important period in the life of the bug, since the rapid accumulation of fat, which occurs then, is essential for successful overwintering and oviposition in the following spring.

Foci of mass reproduction of the bug in the European part of the Union are related to two types of hibernation quarters, mountains and plains, which determine the distribution and behaviour of the bugs. Density of the overwintering population is greater in the plains, ranging up to 1,000 or more per sq. m., whereas numbers seldom exceed 50 per sq. m. in the mountains. Outbreaks occur most regularly in wide, concentrated areas of grain production close to mountain sites.

Vinogradova (N. M.). **The act of feeding of** *E. integriceps*, pp. 73–86, 8 pls., 5 figs., 24 refs. Although the results of feeding by *E. integriceps* on the grains of wheat have received detailed study, the mode of feeding of the bugs has been little investigated and they have been considered to feed on the grains only before the ripening process is complete. Investigations in 1950–56 showed that feeding was divisible into three phases, preparation for the puncture and the actual puncturing of the grain, mechanical preparation of the substrate and the introduction of chemically active substances with the saliva, and finally the uptake of the diluted and partly digested food by periodic pumping action and its final digestion and assimilation. These processes, which take a considerable time, are described in detail for both nymphs and adults, and it is shown that the bugs are able to feed on completely ripe grains, which are in fact more nutritive than unripe ones, though the initial processes require a greater

effort and a greater amount of saliva is injected into them. The feeding cones formed in the grains, and the condition of the grains after feeding are described. Both nymphs and adults were occasionally observed feeding on individuals of their own species and on the eggs, in laboratory and field.

Bel'kevich (V. I.). **Contribution to the study of problems of the physiology of** *E. integriceps*, pp. 87–100, 1 fldg. table. The following is based on the author's summary of the results of the investigations described. The nymphs and adults of *E. integriceps* prepare their food by a process of extra-intestinal digestion, which enables them rapidly to assimilate it and accumulate reserve substances. Feeding on ripe grains takes place comparatively rapidly because the food is hydrolysed by secretions from the salivary glands containing powerful carbohydrases (invertase and amylase) and proteinases, which convert it into an easily absorbed mass. Feeding on ripe grains increases the population of overwintering bugs and the likelihood of damage in the following year. Harvesting should therefore be done early and rapidly, so as to deprive this part of the population of food and prevent their survival through the winter. The enzymes remain at a high level of activity during the period of mass feeding of the nymphs and young adults, but become less active and are at a low level by the time of the migration from the grain fields. Bugs preparing for hibernation show a reduced water content, increased fat reserves, accumulation of food reserves in the mid-gut, a reduction in the activity of digestive enzymes, a reduction in oxygen consumption, and a reduction in respiration, with a consequent reduction in metabolism, which increases their resistance to poisons and the difficulty of controlling them by means of insecticides.

Paĭkin (D. M.) & Novozhilov (K. V.). **Factors in the effectiveness of DDT for the control of** *E. integriceps*, pp. 101–144, 5 graphs, 65 refs. It is concluded from the detailed experiments described that DDT is best used against *E. integriceps* in dusts, that the concentration in these can safely be reduced to 3 per cent., that talc can be replaced as the diluent by various other materials of similar chemical and physical properties but low sorptive capacity, and that ground treatment is more economical than application from aircraft.

Sazonov (P. V.). **DDT as a means of protecting crops from** *E. integriceps*, pp. 145–196, 8 graphs, 51 refs. Investigations in the Stavropol region, the results of which are recorded in detail, showed that DDT dusts are best applied for the protection of winter wheat from damage by *E. integriceps* soon after the nymphs have hatched but before they reach the fourth instar. A period of some 15 days is thus available for treatment, and the DDT has a stimulating effect on the growth of plants that have been damaged by the overwintered adult bugs. Dusting before the nymphs have hatched does not give sufficient protection, and a second application may be required.

Mende (P. F.). **Data on the effectiveness of the chemical method of control of** *E. integriceps*, pp. 197–211, 1 graph, 8 refs. In experiments in the Krasnodar, Saratov and Stavropol regions, dusting with 5·5 per cent. DDT gave good control of the overwintered adults of *E. integriceps* on winter wheat and reduced the subsequent nymphal populations when carried out at the time of oviposition, but not before, probably as a result of the physiological condition of the bugs. Toxicity of the deposits persisted for not more than 5–6 days. In comparative tests, dusting with Wofatox (2·5 per cent. methyl-parathion) on slate dust gave poor control of the overwintered bugs in the Kuban, but proved effective on the middle Volga and was also highly toxic to the nymphs. Bundles of straw treated with various insecticides and distributed in fields as refuges for the bugs were also effective. Parathion gave good mortality when used in this way, but

a material of unspecified composition termed preparation no. 47 was even better; the bundles should be used at the rate of about 1,000 per acre for good results.

Control of the overwintering bugs in forest districts in the Krasnodar and Rostov districts was achieved by spraying in spring with various insecticides, of which the most effective were preparation no. 47, parathion and a solution of methanesulphonyl fluoride in green oil, of which the last was the best [**42** 148].

Fedorova (I. N.). **Duration of effectiveness of DDT against the nymphs of *E. integriceps* in relation to the form in which the preparation is used,** pp. 213–224, 4 graphs, 5 refs. DDT is usually applied against *E. integriceps* at the time when the bugs are at their most resistant, and the duration of effectiveness of the treatment is therefore of importance. In the field experiments described, 1·98 lb. DDT per acre in a dust gave 12·6 per cent. mortality of the nymphs after four days and 30·2 per cent. after eight, 2·16 lb. in a suspension gave 42·6 and 57·7 per cent., respectively, 1·08 lb. in a suspension gave 4·4 and 26 per cent., and 1·08 lb. in diesel oil gave 2·3 and 2·7 per cent.

Païkin (D. M.). **Bases and first results of divided harvesting for the control of *E. integriceps*,** pp. 225–232, 10 refs. Although DDT and other insecticides give good protection of cereal crops from *E. integriceps*, the problem of controlling the bug in the Soviet Union has not been solved by their use, since complete mortality is not achieved and sufficient insecticide is not available for treatment of all the vast areas concerned. Supplementary or substitute measures are therefore required. A study of the physiology of the bug in relation to the growth of cereal crops, in particular of the rate of fat accumulation, together with field investigations showed that early cutting at the state of milky ripeness and before the bugs have migrated to their hibernation sites, followed by as short a period of drying in the field as possible, deprives the bugs of food before they mature and is a useful measure [*cf.* **48** 241].

Bel'kevich (V. I.). **Observations on *E. integriceps* during the period of ripening and cutting of the crop in the Kamen region in 1955,** pp. 233–242, 12 refs. Observations are described showing that although dusting wheat with DDT led to early mortality of the males of *E. integriceps*, the females were more resistant and many of them completed feeding, even on grain that was technically ripe.

Shchepetil'nikova (V. A.). **The effectiveness of the egg-parasites of *E. integriceps* and the factors determining it,** pp. 243–284, 9 graphs, 25 refs. Observations in the Soviet Union have shown that in some years and places egg-parasites give important control of *E. integriceps*, though they seem unable to terminate an outbreak. The parasites concerned are Scelionids belonging to several genera. The commonest is *Microphanurus semistriatus* (Nees). The distributions of these parasites are summarised, and investigations in the laboratory and field on the factors that influence their effectiveness are described. It is concluded from them that the main reasons for the variable degree of parasitism afforded are the lack of coincidence between their life-cycles and that of *E. integriceps*, so that alternative hosts are necessary for their survival in the absence of the bug, and the narrower range of environmental conditions tolerated by them, in comparison with *E. integriceps*. Winter mortality is high, and reproduction is much reduced in cold springs. As a result, parasitism is low at the beginning of oviposition by *E. integriceps* and reaches a high level only towards the end of it. The parasites become really numerous only in years in which their alternative hosts reach high population levels and conditions favour overwintering and adult feeding, and in such years parasitism reaches

a high level early in the season, so that the bug population is suppressed. The parasites can be used effectively by distributing them each year at suitable times in fields in which insecticides have not been applied. For this purpose, they should be collected from their hibernation quarters, which may be artificially provided, and reared in the laboratory. Parasites will in general be favoured if the plants that provide food and shelter for the adults and for the alternative hosts are included in plantations and shelter belts.

Kamenkova (K. V.). **Causes of the high effectiveness of the egg-parasites of** *E. integriceps* **in the foothill districts of the Krasnodar region,** pp. 285–311, 7 graphs, 21 refs. Egg-parasites, principally *Microphanurus semistriatus*, afford important control of *E. integriceps* each year in the foothills of the Krasnodar region, and observations are described showing that the main reason for this is the existence of permanent foci of parasite reproduction in the woods and shrubby growths that surround the grain fields, which provide alternative hosts and overwintering sites for the parasites.

Shumakov (E. M.). **Phasiines as parasites of** *E. integriceps*, pp. 313–321, 1 pl., 4 figs., 32 refs. In view of doubt as to the identity of the Phasiine Tachinids that parasitise *E. integriceps* in the Soviet Union [*cf.* **45** 473, etc.], investigations were made in the Krasnodar region in 1950–53. The species found, in order of frequency, were *Phasia (Alophora) subcoleoptrata* (L.), *Clytiomyia helluo* (F.), *Ectophasia (Phasia) crassipennis* (F.) and *Helomyia lateralis* (Mg.), and a key to the larvae and puparia of these four is given, followed by notes on their habits and local levels of parasitism. All parasitise the adults of *Eurygaster* and reduce egg-production.

Evlakhova (A. A.). **Problems in the development of the microbiological method of control of** *E. integriceps* **in its overwintering sites,** pp. 323–340, 3 graphs, 20 refs. The following is based on the author's summary. Investigations on dead adults of *E. integriceps* found in their hibernation sites in various parts of the Soviet Union in 1951–56 showed that the main factor responsible for mortality was *Beauveria bassiana*, which became particularly effective towards the end of the overwintering period. Other agents were the non-sporeforming bacteria, *Chromobacterium prodigiosum* and *Pseudomonas pyocyanea*. High mortality was the result of a coincidence of a weakened physiological state of the bugs with favourable weather and biotic factors. Older bugs were more susceptible to infection by fungi than younger ones. The observations may serve as a basis for microbiological control of *E. integriceps*.

Suzdal'skaya (M. V.). **The white muscardine fungus of** *E. integriceps*, pp. 341–361, 2 graphs, 32 refs. Observations on the effectiveness of *Beauveria bassiana* as a factor in the control of the hibernating adults of *E. integriceps* were begun in European Russia in 1947, and the results obtained in the various years are discussed. Mortality was variable but sometimes very high, depending on the site, the weather and the density of the bugs, and infection was shown to spread from one insect to another. Mortality was also caused by *Spicaria farinosa*. The symptoms of infection and the ecology of *B. bassiana* are discussed, and experiments on the susceptibility to infection of bugs of different ages and degrees of nutrition are recorded. Overwintered bugs are very susceptible, especially after they reach the grain fields, but the nymphs and newly emerged adults are more resistant.

Sazonov (P. V.). **The work of the first international conference on the control of** *E. integriceps*, pp. 363–370. This is a brief account of the FAO meeting on the control of *E. integriceps* held in Turkey in December 1956 [*cf.* **47** 189].

Kennedy (J. S.), Booth (C. O.) & Kershaw (W. J. S.). **Host finding by aphids in the field. I. Gynoparae of** *Myzus persicae* **(Sulzer).**—*Ann. appl. Biol.* **47** no. 3 pp. 410–423, 3 figs., 25 refs. London, 1959. **II.** *Aphis fabae* **Scop. (gynoparae) and** *Brevicoryne brassicae* **L.; with a re-appraisal of the role of host-finding behaviour in virus spread.**—*T.c.* pp. 424–444, 8 figs., 48 refs.

The following paragraphs are based on the authors' summaries of the two parts of this paper, respectively.

Attempts in the laboratory to test the theory that aphids are attracted to their food-plants by an olfactory stimulus gave no definite results, and more conclusive evidence was sought by recording the behaviour of migrants in finding their food-plants in the field in south-eastern England. The first of three occasions on which the natural alighting rate was high enough for comparative purposes was an autumn migration dominated by *Myzus persicae* (Sulz.) returning to its specific overwintering food-plant, peach, in 1947. The proportion of gynoparae of *M. persicae* among all aphids caught alighting on spindle (*Euonymus europaeus*), a tree on which *M. persicae* does not overwinter, was as high as on peach, but there was a much heavier accumulation of migrants on peach. This was due, not to a differential rate of alightment, but to the differential rate of departure of the aphids, the average stay on peach being longer. The proportion of gynoparae of *M. persicae* was smaller in catches on transparent adhesive traps than among alighters on the trees, and they avoided alighting on plants of brussels sprouts more often than on peach. Only a fraction of those that approached the plants alighted, even on peach; and only a small fraction of those that did alight stayed, even on peach. There was appreciable colonisation of spindle and brussels sprouts by the gynoparae and some 'wasted' oviposition by their progeny on spindle. After the migration was over, the peach leaves entered the last stages of senescence before the spindle leaves, and gynoparae (no longer able to fly) that were given access to both at that time settled preferentially on spindle. The distribution of males created the impression that they were less specific than the gynoparae with regard to the food-plant.

In the autumn of 1957, gynoparae of *Aphis fabae* Scop. occurred in the same large proportions in simultaneous collections of all aphids alighting on, probing, and taking off from a food-plant (spindle) and peach, a tree on which this aphid does not feed, and behaved in a similar manner when approaching and leaving the two trees under the same conditions. Most alighters took off again from leaves of both kinds within a few minutes, staying longer and probing more often on the food-plant. In atmospheric conditions favouring local 'hovering' instead of dispersal, flying and alighting aphids became concentrated round food-plants, not through any specific attraction to them, but apparently because more aphids had accumulated on them and were then taking off. In the late summer of 1952, *Brevicoryne brassicae* (L.) occurred in the same large proportion in simultaneous collections of aphids alighting on a food-plant (cabbage) and a plant on which this species does not feed (sugar-beet). No satisfactory evidence was found of preferential alightment on cabbage, and there were indications of preferential alightment on sugar-beet. A very small minority of the aphids of both species that alighted on their food-plants stayed there long enough to reproduce. This minority was rather larger among alighters late in the day, but, in the absolute sense, more colonisation occurred during earlier periods when more aphids arrived. The intensely dispersive type of behaviour in finding food-plants observed in *M. persicae*, *A. fabae* and *B. brassicae* may be common among aphids. It seems ideal for the dissemination of non-persistent plant viruses, more particularly among the

less favoured food-plants of each aphid. The tendency to commensal association between virus and vector provides an ecological framework that may govern the incidence of virus-vector specificity and symbiosis.

Burges (H. D.). **Studies on the Dermestid beetle** *Trogoderma granarium* **Everts. III. Ecology in malt stores.**—*Ann. appl. Biol.* **47** no. 3 pp. 445–462, 7 figs., 10 refs. London, 1959.

The following is almost entirely the author's summary of this third part of a series [*cf. R.A.E.*, A **47** 375, etc.]. Detailed studies over a period of five years on the environment in malt stores in Britain and its effect on *Trogoderma granarium* Everts are described, and the observations are correlated with the conclusions from parallel laboratory work. Bulks of malt are stored at 26–69°C. [78·8–156·2°F.], and cooling near their centres is slow. After loading, the distribution of heat is controlled mainly by the position of the kiln, the size of the store and the development of *Trogoderma* infestations. Three zones of temperature may be recognised, too hot for *Trogoderma* (above 40°C. [104°F.]), favourable (30°C. [86°F.]–40°C.) and too cool for rapid breeding (below 30°C.). Population growth may be progressively retarded by cooling, or heat from the kiln and insect-heating may allow continuous breeding, although part of the malt may be heated above 40°C., causing migration of the larvae. Some migrants stop in a new favourable zone, and others continue into the cool zone, often for a long way.

The larva is the most prominent stage in most populations. Throughout population growth, low temperature and the accumulation of faecal pellets cause some larvae to enter diapause and hide either in crevices or on the walls just below the malt surface. After the malt is unloaded, huge numbers of larvae may be hidden and some may survive for more than four years. Reloading with new, hot malt stimulates some of the hidden larvae to emerge, pupate and breed. More larvae emerge from the hottest positions than from elsewhere. The very sharp gradient of humidity in stores does not appear to influence larval behaviour. In contrast to unmalted cereals, malt is too dry to allow a significant upward translocation of moisture above a hot region.

Control is very difficult. Current methods involve persistent attack on larvae in empty stores with methyl bromide and contact insecticides, combined with structual improvements. Control by cooling the malt before storage shows promise. A bulkhead separating the malt from the kiln walls by 50 cm. sometimes allows the malt to cool fast enough to check the development of infestation, even where larvae are abundant in the kiln walls; and in two instances, light infestations in malt transported to brewery silos by road did not subsequently increase, probably because the malt was cooled during the journey.

Jepson (W. F.). **The effects of spray treatments on infestation of the oat crop by the frit fly (*Oscinella frit* L.).**—*Ann. appl. Biol.* **47** no. 3 pp. 463–474, 7 refs. London, 1959.

The following is almost entirely the author's summary. Criteria are given for the timing and assessment of the effect of sprays against *Oscinella frit* (L.) on experimental cereal plots, based on biological observations in southern England from 1950 to 1955 [*cf.* also *R.A.E.*, A **47** 219] and on previous work, and subsequently used for the development of a technique for surveying losses caused by *O. frit* [**47** 221]. A preliminary experiment

on small plots of oats in 1952 indicated that repeated spraying (blanket treatments) with DDT at 2 or parathion at ½ lb. per acre throughout the life of the crop gave protection against both tiller and grain attack. A more detailed replicated plot trial in 1953 showed that, for oats sown on 29th April, two carefully timed tiller sprays of parathion at ¼ lb. per acre reduced tiller infestation from 31 to 3 per cent. Six panicle sprays at weekly intervals reduced a heavy grain attack from 60 to 13 per cent. Dieldrin at ¾ lb. per acre was also effective, but significantly less so than parathion. Much of the damage to the crop was caused by weed growth following initial loss of the primary oat shoots. In 1954 and 1955, two and three sprays of parathion at ¼ lb. per acre were applied by low-volume equipment at 80 gal. spray per acre to two-acre fields of oats in order to study recolonisation. Despite almost complete control of the tiller generation, a normal evenly distributed infestation of the panicles was found. It is concluded that good control of the tiller generation may best be achieved by a spray programme based on knowledge of the phenology of the fly combined with that of the crop. The first general emergence in early May is likely to be critical. Reinvasion of a sprayed crop may take place within 4–5 days, and panicle infestation may not be causally related to tiller infestation in the same field.

Work in 1957 indicated that a properly timed single application of endrin at ¼ lb. per acre gives results similar to those obtained with DDT and parathion and can be combined with an early application of weed-killer.

Dunn (J. A.). **The biology of lettuce root aphid.**—*Ann. appl. Biol.* **47** no. 3 pp. 475–491, 4 graphs, 7 refs. London, 1959.

The following is based partly on the author's summary. The lettuce-root aphid, *Pemphigus bursarius* (L.), sometimes causes considerable and widespread damage to crops of outdoor summer lettuce in England. Infested plants become stunted and the leaves turn yellow, but usually the first symptom of attack is wilting, which is often followed during drought by the collapse and death of the plants. During investigations on the bionomics of the aphid, begun in central England in 1955, the preferred primary food-plant was found to be Lombardy poplar, *Populus italica*. At bud-burst (late March to late April), eggs that have overwintered on this or other species of poplar hatch and the fundatrices cause the development of hollow, flasked-shaped galls on the leaf petioles. Each fundatrix becomes enclosed within a gall, and development lasts an average of 12 days in the laboratory at a mean temperature of 65°F. and about 6–7 weeks in the field. Each fundatrix gave rise to 100–250 alate fundatrigeniae, which also matured in about 12 days at 65°F. On developing wings, these remain in the gall for about two days and then migrate to lettuce and other secondary food-plants. They reproduce almost immediately and deposit apterous progeny either on the foliage, from which the young aphids quickly move to the soil, or, less often, on the soil near the plant. Several apterous generations are produced, and the colonies secrete wax, which gives the roots a characteristic mealy appearance. In the field, fundatrices mature at about the end of May and the winged fundatrigeniae usually begin to emerge in the last two weeks of June. In a field of lettuce in which alates were first found on 30th June and into which migration continued until the first week of August, although the crop was harvested on 20th July, peak numbers of migrants were found on 12th July. Lettuce sown between mid-April and the end of May is the most severely attacked, while that sown in July escapes. The secondary food-plants of the aphid belong to the sub-family Liguliflorae of Compositae, and, although lettuce is preferred by the

fundatrigeniae, *Lapsana communis* and *Sonchus asper* often have large colonies on their roots. The size of the mature apterae varies between food-plants and is greatest on lettuce and *S. asper*. The winged alienicolae are all sexuparae and fly back to poplar. Thus alternative secondary food-plants are not reservoirs for lettuce-infesting alatae. The sexuparae appear on lettuce from about the last week in August. They generally come to the surface of the soil and settle round the collar of the plant to mature and develop their wings, and migration occurs mainly in September and early October, though it may continue into November. Having flown back to the primary food-plant, the sexuparae seek out crevices in the bark, where they produce arostrate sexuales. The ovipara contains one egg, and, after mating, crawls as far into the bark crevice as possible and deposits it.

Gates (L. F.). **Seed and soil treatment with systemic insecticides to prevent aphid colonization of emerging beet seedlings.**—*Ann. appl. Biol.* **47** no. 3 pp. 492–501, 1 fig., 3 refs. London, 1959.

The spread of virus yellows in root crops and steckling beds of sugar-beet in Britain can be checked by spraying with systemic insecticides [*cf. R.A.E.*, A **41** 308], but germination of seeds sown in July and August is often irregular, and this may affect the degree of control, since *Myzus persicae* (Sulz.) and *Aphis fabae* Scop., the vectors of the virus, sometimes infect seedlings that emerge before the first spray is applied or between the early sprays. The value of seed and soil treatments with such insecticides in protecting emerging seedlings was accordingly tested in the field in eastern England in 1953–56, and the following is based on the author's summary of the results. Dimefox and phorate (Thimet) applied at 2 and 1 lb. active ingredient, respectively, in 100 gal. water per acre along the drills before sowing, and phorate and O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (Disyston) used as seed dressings at rates giving 6–8 and 8–24 oz. active ingredient per acre, respectively, rendered sugar-beet seedlings toxic to aphids for up to 30 days after sowing in four root crops sown in April–May and for up to 30–40 days after sowing in five steckling crops sown in autumn. Malathion, demeton, methyl-demeton, mazidox and schradan were less effective. The infestation by *M. persicae* was decreased by the treatments for a period that is often critical for virus infection in summer-sown stecklings and occasionally in spring-sown root crops. Germination amounted to 73–100 per cent. of that in the controls after soil treatments, 91–98 per cent. after seed dressings with Disyston and 62–84 per cent. after seed dressings with phorate. The treatments slightly decreased injury by *A. fabae* to steckling seedlings in 1955 and the number of plants with yellows in a steckling experiment in 1956.

Casimir (M.) & Jones (E. L.). **BHC and aldrin spraying of hopper bands of the Australian plague locust** *Chortoicetes terminifera* **Walk.**—*J. Aust. Inst. agric. Sci.* **24** no. 2 pp. 141–145, 3 figs., 3 refs. Sydney, 1958.

Population densities of hopper bands of *Chortoicetes terminifera* (Wlk.) in north-eastern New South Wales were estimated before and after the application of sprays of BHC and aldrin in September 1954. The boundaries of three roughly rectangular swarms were marked by wooden stakes, and sample counts of the hoppers enclosed within a wire quadrat, 1 ft. square, that was gently lowered over them were made within the swarms at predetermined distances along transects ten yards apart; for similar counts

outside the marked boundaries, the quadrats employed were each one yard square. Counts in the untreated bands were made in the early morning, when the hoppers were inactive and tended to form basking groups [*cf. R.A.E.*, A **38** 388], and densities of up to 294 per sq. ft. were found; the hopper band was immediately sprayed with insecticide, and further counts were made about 24 hours later.

Hoppers in the first three instars in a band about one acre in extent on almost bare ground that on 26th September were sprayed with an emulsion affording 3½ oz. γ BHC per acre were nearly all dead 2–3 hours later, and mortality in the treated area was complete by the next day. Many hoppers of similar age in a band ½ acre in extent that was sprayed on 27th September with 3 oz. wettable γ BHC per acre were still alive three hours after treatment, but none was alive in the treated area on the next day. Mortality among hoppers in a similar band treated on 29th September with aldrin at 4 oz. per acre in an emulsion spray was low several hours after the application, but was complete in the treated area by the next day The counts indicated that considerable numbers of hoppers moved a few yards out of the sprayed areas, but survival among these was negligible. In view of the efficiency of the insecticides, the tendency of the hoppers to disperse evenly over the area as the temperature rose and the additional disturbance caused by spraying, the counts made after treatment gave less variable results than those before it and could be used to estimate the total numbers in the bands. These were estimated to be 1·1–2·1, 0·9–1·6 and 0·2–0·6 million hoppers for the three bands, respectively.

Braithwaite (B. M.), Jane (A.) & Swain (F. G.). *Amnemus quadrituberculatus* (**Boh.**), **a weevil pest of clover pastures on the north coast of N.S.W.**—*J. Aust. Inst. agric. Sci.* **24** no. 2 pp. 146–154, 4 figs., 4 graphs. 2 refs. Sydney, 1958. **Effect of insecticides on sod-sown sub clovers.**—*T.c.* pp. 155–157, 1 ref.

Attempts to introduce leguminous plants into nitrogen-deficient pastures in the northern coastal district of New South Wales have been hindered by *Amnemus quadrituberculatus* (Boh.). This weevil was of little importance until the winter of 1956, when it destroyed nearly all the pastures into which subterranean clover (*Trifolium subterraneum*) had been sod-seeded (directly sown) and, in 1957, field and laboratory investigations on its bionomics and control were begun. These are described in the first paper, which also contains brief descriptions of the egg, larva and adult.

A. quadrituberculatus is confined to Australia, where it is recorded only from coastal districts between south-central New South Wales and south-central Queensland. Surveys in New South Wales in 1957 showed that it was widespread from the Tweed to the Manning Rivers and occurred on a wide range of soils, in natural clover pastures and in clover pastures sown in various ways, though only on well-drained soils. Heavy larval populations caused very severe damage to clovers in some localities, and extensive damage to subterranean clover was reported in one district in June 1954. Feeding by the adults on the leaves and petioles of the clover is of little importance, but the larvae feed on the roots, especially the tap-roots and stout stolons, and may sever the tap-root at a depth of about ½ in.; the depth at which they feed appears to depend on the moisture content of the soil and extended down to 9 in. Fibrous roots usually develop above the damage, and the weakened plants survive if the surface soil is moist, but wilt and die if it dries; grazing stock hasten the death of the plants

by breaking them off where the larvae have fed. The damage is more apparent in clovers with well-defined tap-roots than in white clover (*T. repens*) and other species with fibrous roots or a stoloniferous habit, but though heavily infested stands of the latter class may appear healthy, they usually make little growth.

The adults, which are inconspicuous even when numerous, do not fly but can move rapidly and spread fairly quickly. They are present from spring until early winter and are probably most active in November–March; none was found after June. They feed on a wide range of leguminous plants, among which *Desmodium sandwichense* is preferred. Oviposition begins several weeks after emergence, and pairing occurs throughout the egg-laying period. From daily counts in the laboratory, made from 1st April (when oviposition had probably been in progress for at least two months), it was estimated that the females lay 1,000–2,000 eggs each, though limited observations in the field indicated the deposition of only a quarter of this number. The eggs are laid in the central hollow of the petiole, usually in the lower part, and commonly in groups of 3–4, though up to 14 were found. They are known to be laid in red clover (*T. pratense*), white and ladino clover (*T. repens*), alsike clover (*T. hybridum*) and subterranean clover, and may be restricted to species with hollow petioles or stems. In the laboratory, the eggs hatched in 10–51 days; an average of 68 per cent. of those laid in April were viable, but viability declined considerably in the cooler weather. The newly hatched larvae apparently drop immediately to the soil. Larvae in all stages were present from March to November or December, but older larvae, prepupae and pupae became increasingly abundant from August onward. Most larvae passed through seven instars in 12–16 weeks, and the prepupal stage lasted 2–9 weeks. In the glasshouse, they fed on berseem (*T. alexandrinum*), four strains of subterranean clover, and cowpea, and, in the field, vetches (*Vicia*) were damaged as well as clovers. Pupation takes place in earthen cells under, but not closely associated with, the clover roots. Pupae are most numerous in spring, and the pupal stage lasted 18–26 days in the glasshouse. White clover is probably the natural food-plant of the weevil.

In tests on control, insecticide dusts were applied with a fertiliser. No success was obtained when dieldrin, aldrin, chlordane, DDT or γ BHC was broadcast over established subterranean clover sod-seeded into pastures, largely because of extraneous factors, but when dieldrin at 2 lb. per acre was applied to a stand of native white clover in a grass pasture in January, March or June, the earliest application significantly reduced the mean number of larvae per plot. In March 1957, a grass pasture almost devoid of native clovers was sod-seeded with subterranean clover, and dieldrin, aldrin, chlordane, DDT and γ BHC, mixed with neutralised superphosphate, were also applied with the sod-seeder, at 2, 4, 8, 10 and 1·5 lb. per acre, respectively. In June, seedling counts showed that the first four materials gave good protection from attack by miscellaneous insects, notably crickets, but damage by *A. quadrituberculatus* did not occur and, owing to the absence of white clover in the area, was not expected before the second crop year.

This experiment was also used to study the effect of the insecticides on root-nodule bacteria (*Rhizobium*), and the results are given in the second paper. Inoculation of the seed with the bacteria is essential for the successful establishment of subterranean clover in north coastal districts, and it was found that aldrin, dieldrin and chlordane had relatively slight effects, mainly reducing the number of nodules on the tap-root, but that DDT and, particularly, BHC affected the nodules on the rest of the root system, so that their use with inoculated seed is not recommended.

Nijveldt (W. C.). **Levenswijze en bestrijding van de aspergevlieg** (*Platyparea poeciloptera* **Schrank) in Nederland.** [The bionomics and control of *P. poeciloptera* in Holland.]—*Versl. Landbouwk. Onderz.* no. 63.4, 40 pp., 18 figs., 39 refs. The Hague, 1957. (With a summary in English.)

Platyparea poeciloptera (Schr.) appeared as a harmful pest of asparagus after the war in parts of Holland, especially in areas neglected because of prevailing conditions. All stages of this Trypetid and its bionomics are described. The adults emerge from the overwintered puparia from late April and are present until early July. The eggs are laid in the young stems as soon as these appear above the soil and hatch in 3–10 days, depending on temperature. The larvae tunnel in the stems for 27–38 days, killing many, and pupate in them at depths of 2–4 in. below soil level. There is only one generation a year, and experiments showed that the adults were able to reach the surface from depths as great as 16 in.

Most damage is done to plants 1–2 years old; the stems of older ones are cut as soon as they appear, and oviposition is thus prevented. The adults are thermophilous, being most active at 20–25°C. [68–77°F.] and hardly move at temperatures below 15°C. [59°F.], although they can survive periods of unfavourable weather. They live for 4–24 days, and the scent of the asparagus stems was found in the laboratory to be the principal stimulus for oviposition. Natural enemies afford little control, and the results of tests with insecticides, both systemic and other, were not promising. Cultural measures are therefore recommended, including the cutting off of infested stems as deeply as possible in the soil.

van de Vrie (M.). **Biologie en bestrijding van de aardbeimijt.** [Bionomics and control of the strawberry mite.]—*Meded. Dir. Tuinb.* **20** pp. 433–438, 15 refs. The Hague, 1957. (With a summary in English.)

Stenotarsonemus (*Tarsonemus*) *pallidus* (Banks), the bionomics of which are reviewed, has long been injurious to strawberry in Holland. Sprays of phosphorus compounds gave poor control, because of their short period of effectiveness, but details are given of tests from which it is concluded that sprays of 0·25 per cent. Kelthane or 0·1 per cent. endrin give commercial control when applied once after harvest.

Gustafsson (M.). **Significance of droplet size in spraying with insecticides.** —*Medd. Växtskyddsanst.* **11** no. 73 pp. 81–130, 22 figs., 27 refs. Stockholm, 1958. (With a summary in Swedish.)

The following is based on the English summary. There is an optimum droplet size for sprays applied to vegetation for insect control; very small droplets are liable to follow the air stream past the insects and foliage, evaporating very quickly, sedimenting slowly and needing great initial velocity for deposition, and very large ones are unevenly distributed on the foliage and run off at once. In judging spray equipment, the mass median diameter of the droplets produced and the limits in size of the droplets constituting most of the spray volume must be considered, together with methods of varying them by means of different nozzles and pressures and the amounts of active material deposited on the vegetation when different mass median diameters and droplet distributions are used.

Laboratory tests were carried out in Sweden with various insecticides, all but nicotine applied in emulsion sprays, in which effectiveness is influenced

by the nature of the oil, emulsifier and wetting agent, the electrolytes present and the pH of the liquid, as well as by the toxicant itself. With droplets of 100, 280 and 500μ m.m.d., the smallest size was the most effective for DDT applied to foliage subsequently infested with adults of *Meligethes aeneus* (F.), and larvae of *Pieris rapae* (L.) and *P. brassicae* (L.) or directly to adults of *Sitophilus* (*Calandra*) *granarius* (L.), whereas droplet size had no effect when wooden plates were sprayed with DDT and adults of *S. granarius* confined on them. The smallest and largest sizes, respectively, were the most effective for parathion against *Ceutorhynchus* spp. and demeton (Systox) against *Anuraphis* (*Brachycaudus*) *helichrysi* (Kalt.) or *Brevicoryne brassicae* (L.), but droplet size did not affect the results with nicotine against *A. helichrysi*. In sprays of different concentrations, the quantity of active material was important, but not the amount of spray.

In field tests with droplets of 70, 100 and 210μ m.m.d., the two smaller sizes gave the best results with DDT against *M. aeneus* on rape and the largest with demeton against aphids on sugar-beet, whereas parathion, applied to rape against *M. aeneus* and *Ceutorhynchus* spp., showed no differences due to droplet size. It is pointed out that, in field experiments, careful meteorological and ecological observations should be made, and evaporation should be measured with a simple atmometer, particularly for parathion and the systemic insecticides.

The good results given by large droplets of demeton spray are due to the great volatility of the compound. Experiments with a solution of common salt, applied in droplets of 70, 100 and 210μ m.m.d. showed that most salt residue was recovered at the medium droplet size, and the good results with DDT at this size are probably due to the fact that at it the greatest amount of active substance is deposited on the vegetation. When a fluorescent substance was added to spray liquids, in order to study the distribution and wind drift of the insecticides, droplets of the medium size were the most evenly distributed in a vertical and horizontal line and flowed together the least, thus reducing run-off.

Papers noticed by Title only.

Franssen (C. J. H.) & Huisman (P.). **De levenswijze en de bestrijdingsmogelijkheden van de vroege akkertrips** (*Thrips angusticeps* **Uzel).** [The bionomics and control of *T. angusticeps* (on flax in Holland).]—*Versl. Landbouwk. Onderz.* no. 64.10, 103 pp., 4 pls., 5 figs., 55 refs. The Hague, 1958. (With a summary in English.) Also as *Meded. Inst. PlZiekt. Onderz.* no. 183. [For shorter account see *R.A.E.*, A **46** 331.]

Karaman (Z.). **Beobachtungen zum Auftreten der Nonne** (*Lymantria monacha* **L.) 1955/56 in den Buchenwäldern Westmazedoniens, Jugoslawien.** [Observations on the occurrence of *L. monacha* in 1955–56 in the beech forests of western Macedonia, Jugoslavia.]—*Z. angew. Ent.* **42** pt. 2 pp. 236–238. Hamburg, 1958. (With a summary in English.) [*Cf. R.A.E.*, A **46** 397.]

Bocharova-Messner (O. M.). **A peritrophic membrane in the intestine of** *Eurygaster integriceps* **Put.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **126** no. 6 pp. 1381–1384, 2 figs., 16 refs. Moscow, 1959.

Palmer-Jones (T.). **Laboratory methods for measuring the toxicity of pesticides to honey bees.**—*N.Z. J. agric. Res.* **1** no. 3 pp. 290–300, 4 figs., 17 refs. Wellington, N.Z., 1958.

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